THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE

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(J. A. BERLY'S).

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METROPOLITAN ELECTRICITY SUPPLY UNDERTAKINGS.

THE electricity accounts of all Metropolitan Boroughs have, on the instruction of the Local Government Board Auditor, hitherto been based upon the principle of "Receipts and Payments," notwithstanding the fact that the Board of Trade has set out a specified form of accounts upon a somewhat different principle. It has now, however, been decided to adopt the principle of "Income and Expenditure" in Metropolitan accounts, so that, in future, all accrued income and expenditure will be calculated and included in the balance-sheet at March 31st of each year. This change will undoubtedly affect the financial statements of most metropolitan municipal undertakings to a considerable extent, as accrued redemption of loans is to be included in addition to the estimated discount off consumers' outstanding accounts; it will also have the advantage of showing the true position of each undertaking's finances, subject, of course, to proper provision being made for depreciation, a provision which must not be confounded with redemption of loans. At this juncture we would urge upon the Local Government Board the necessity of reconsidering the system upon which loans are repaid with a view to entirely abolishing the annuity system. A borough that is financed entirely in the latter manner is constantly accumulating indebtedness, whereas by making repayments upon the instalment system the outstanding debt is not increased, provided the annual capital expenditure does not exceed the amount repaid. We published in our issue of June 28th an article on "Depreciation," showing clearly the monetary difference between the two systems at various stages of loan repayments. If we assume that the £250,000 of capital there referred to had been borrowed at $3\frac{3}{4}$ per cent. upon the annuity system, the constant annual charge upon the undertaking would be £11,900 13s. 4d. for 42 years, but by the instalment system the annual charge commences at £15,325, diminishing by £223 2s. 6d. per annum, until the final payment of £6,183 10s. is made. It must be quite clear to everyone concerned, that should the future annual capital expenditure equal the amount of annual repayments, in the case of the annuity system the annual charge will be increased to the extent of interest *and* repayments on the new loans, whereas in the case of the instalment system, the interest will be stationary and *repayment of new loans only* will be added—a vastly different matter. We would also point out that by the instalment system repayments are made annually and interest paid quarterly, but in the case of annuity loans, half-yearly payments of capital and interest are required, and *compound* interest is charged to balance with the quarterly payments on the instalment system. The excess interest charged by compounding during 42 years in the example we have taken, is £3,295—no negligible item. It may be argued that it would

have cost this sum to overdraw on bankers in order to pay interest quarterly instead of half-yearly. In the old days of lighting undertakings this argument might very well have applied, when the income for the two light quarters was small, compared with that of the two dark quarters, but with the advent of power supply we may expect each quarter to account for itself and show a profit, so that any liability incurred during a given quarter should be met by the income accruing to that quarter.

With the decision of the L.G.B. auditor the opportunity arises to adjust the system of loan repayments, and we, therefore, suggest that Metropolitan Boroughs should be granted the option of paying interest on all loans to a given date, *i.e.*, of taking up the old bonds, and granting fresh bonds for the whole outstanding debt at the respective rates of interest, or one bond with equated interest, and repayments to be made in future by quarterly instalments. This adjustment would meet the views held by the auditor and surmount a difficulty which we think he has failed to appreciate. In strictly accurate accounting there can be no such thing as accrued repayment of loans; an instalment is due at a fixed date and interest is paid to that date for the use of the money; if it is made compulsory to provide a proportion of such instalments before they actually fall due, it should not be expected to earn interest on that proportion also, as it is impracticable to place such sums other than by deposit at the bank.

But there is a much greater object underlying our suggestion than merely making a financial adjustment. By the system of annual repayments it is only possible to make a reliable balance annually. With the adjustment proposed quarterly balances would be practicable, and if we take into consideration the rapid strides at present being made in the electrical industry, it is desirable that each undertaking should ascertain its position more frequently than, as at present, by annual balances. If a power supply undertaking can be made to pay during the quarters ending June and September 30th, it is certain that it can be made to yield an annual profit of sufficient proportions to place it in financial security.

Telephone Cables.

The Pupin cable recently laid across Lake Constance has excited considerable interest, but, apart from the fact that it has helped to show that it is possible to manufacture such a cable and to lay it under comparatively easy conditions, it has proved nothing; a length of 7½ miles is absolutely useless for testing speaking conditions, and leaves the practical value of the Pupin theory unadvanced.

Although a considerable amount of experimental work, and a much greater amount of theorising, has been done with reference to telephone cables, the amount of real progress which has been made is but small. True, more than one cable has been laid, and the results have been stated to be satisfactory, *i.e.*, the speaking qualities have been all that could be desired, but, in the majority of cases, this has not been due to the fact that certain theories which have been put into practice have proved correct, but simply that the lengths of the circuits have been so short that even if the theory and practice had been altogether wrong, the speaking limit would not nearly have been reached; in fact, the speaking may have proved to be good, not in consequence of the improvements, but in spite of the so-called improvements. Broadly speaking, the general impression appears to be that the more "inductance" there can be introduced in a distributed form along a cable, the better will be the speaking; in the majority of cases there has been an entire absence of capability of distinguishing between "inductance" and what has been termed "magnetic inertia." We may, for example, have two bobbins of copper wire, one wound with a large number of turns of thick wire, the other with a small number of turns of fine wire, the resistances of the two bobbins being exactly alike; but the inductance of the bobbin with the large number of turns of thick wire will, in virtue of these turns, be higher than that of the bobbin of fine wire. By introducing an iron core into the latter bobbin, however, the inductance—in the generally understood meaning of the term—may be brought up to the inductance of the thick-wire bobbin. But the two bobbins will not be alike; measured by the secohmeter at low frequencies they may show approximately the same inductance, but measured at high frequencies they may show a wide divergence; this divergence will be greater if the iron core is solid, and less if it is finely laminated. For telephonic purposes the bobbins with the solid cores may be worse than useless, they may introduce so much "impedance," or "magnetic inertia," as to choke the speech; whereas the bobbin with the laminated core may or may not improve the speaking, according to the general construction of the bobbin and the fineness of the lamination of the iron. If "inductance"—in the commonly understood meaning of the term—were the only factor to be considered, an iron wire telephone loop should speak better than one of copper wire, since an iron wire loop, of such a gauge as to be equal in resistance to a smaller wire of copper, has many times the inductance; but course, as is well known, the speaking value is very much lower. The iron wire, in fact, has "magnetic inertia"; the copper wire has not, or only very slightly so.

The German Electrical Industry.

The large manufacturing companies of Germany look back upon the year 1906-7 as a prosperous period, and the dividends are expected at least to equal those which were paid for the preceding 12 months. As to the future, there are at last indications which point to an inevitable connection between the general economic circumstances and the electrical industry, especially the strained monetary situation. A prominent member of one of the leading companies declared about a week ago that although an abundance of orders is coming to hand from foreign countries, particularly Italy, Russia and France, the pressure of the unfavourable position of the money market in Germany is making itself felt by a postponement of the installations and orders proposed in the inland market. The high rates demanded for loan money in Germany impose the necessity upon native industries to defer all expenses on a large scale which are not unconditionally required at once. It is, nevertheless, considered that this may be a development which could not be regarded as undesirable in the general economic interest, as the postponement of large inland works will be of advantage to the money market, and foreign orders would operate in the same respect. The attitude of the high banking circles has doubtless given the incentive to this development, having regard to the extraordinary increase in the demand for credits on the part of inland industries, but some concern is manifested at this situation of affairs, as these banking interests have themselves contributed towards the reduction in the available supplies of money for the home market by the loans granted to other countries in the past year. A further matter in connection with the degree of employment in the electrical industry is afforded by the tendency of the copper market. This point is illustrated by the statement that orders for numerous large installations, that is to say, large undertakings and works, have not yet been placed, as the interested parties count upon a further reduction in the price of copper, and believe that by waiting they will be able to reduce the expenditure. The idea prevailing is that a falling off in the period of prosperity, unless it occurs in an unexpected and harsh way and is lasting, will not have a too unfavourable influence upon the electrical industry, and in the case of any noteworthy reduction of orders, the three eight-hour shifts, which are now largely worked, would be superseded by two shifts of nine hours each.

Smoke.

Mr. Rollo Russell's book and the Coalite scheme have come together conveniently for the latter, and the task of getting every kind of journal consciously, sub-consciously, or unconsciously, to puff this latest invention for making the world clean has been lightened thereby. The *Spectator* took the opportunity afforded by Mr. Russell's sensational but perfectly credible figures of the losses suffered through the dirt produced by smoke, and the sunlight absorbed thereby, to write prettily about smokeless cities. Nothing could be more laudable, and in so doing the *Spectator* carries, not for the first time, our crusade into the wider fields which we can never tread; but our high regard for the *Spectator* does not prevent us from saying—rather, indeed, prompts us to say—that the banishment of fogs is not to be looked for in patent coals or coal substitutes so much as in improved boiler furnaces and domestic grates. The improvements exist, but the will to use them or the knowledge of their being is wanting.

One day we may talk popularly not of smokeless or of smoking coal as now, but of smokeless furnaces; and it will be recognised that lignite, bitumenite, or anthracite may be burned, the one as completely as the other, *i.e.*, without the liberation of carbon and of hydro-carbons in the form of black and brown soot and smoke, simply by the provision of furnaces suitable for each quality.

No one wonders now at the smokeless and intense combustion of town refuse, but most people take the volumes of black smoke poured from the funnels of a torpedo-boat destroyer, or from the chimneys of an iron works, as something indispensable to high power and huge machinery, while the makers of our premier fuel economiser have so little sense of the ludicrous as to embellish their advertisement with trailing clouds of filth, betokening appalling waste.

If cabbage stalks and night soil can be converted into CO_2, H_2O, N and solid residue, with very little or nothing else, the perfect combustion of anything higher in the fuel grade ought not to be questioned, and should be made compulsory.

The dirt caused by the pall over our cities is serious, but the loss of sunshine is infinitely worse, and for that the domestic hearth is co-partner in guilt with the factory.

Householders, with comparatively few exceptions, are making great sacrifices on the altar of the demon of Inefficiency.

A central fire heating ugly or artistic radiators throughout the house; gas fires and gas ovens; electric everything for light and heat; any or all of these used universally would lengthen out the life of our coal deposits and reduce pulmonary and anæmic diseases.

The means are so simple, the end so sure, but the most sanguine do not apprehend improvement at a greatly accelerating rate.

Meanwhile, the jerry builders *à la lanterne*, for they perpetuate the use of the vilest forms of range and hearth.

The Coming of Age of Electrical Engineering.

We have become so accustomed to the continually reiterated expression that "electricity is in its infancy," that it comes to us almost as a shock to learn from a recent issue of *Cassier's Magazine* that the science of Electrical Engineering is on the point of coming of age. In an interesting article on the above subject, Mr. B. A. Behrend points out that "Electrical Engineering," by which he means the electrical transmission of energy, is now on the eve of attaining its majority. The older arts of telegraphy and telephony have long ago come of age, and have taken their places alongside other mature branches of industry.

Regarding the birth of electrical engineering as synonymous with the first practical demonstration of the electrical transmission of energy over a distance, Mr. Behrend fixes the date as that on which about 50 H.P. was transmitted to the town of Soleure, in Switzerland, from a distance of about 5 miles. Curiously enough, he passes over the work of Marcel Deprez, who, in 1886, transmitted 200 H.P. between Creil and Paris, a distance of 56 kilometres, with an efficiency of 50 per cent. The experiments were commenced in November, 1885, and were described in our pages in the following year. The next great step in advance took place when, at the Frankfort Exhibition, some 300 H.P. was transmitted over a distance of 125 miles; shortly after this, the water power of Niagara was utilised in transmitting electricity to Buffalo and other neighbouring towns; since which time the power of the Falls has reached as far as the city of Syracuse, in the State of New York. The recent proposals to transmit electricity from the Victoria Falls, across Africa to the Rand mines, a distance of approximately 700 miles, are evidence of the tremendous strides which the science and art of electrical engineering have made during the past twenty years or so. In what he calls "the realm of ideas," Mr. Behrend sees a distinction between natural ideas and forced ideas, a distinction which he likens to the difference between a plant growing up under favourable and natural conditions, and one raised under the artificial conditions of a hothouse. The "natural idea," he says, will survive, whilst the "forced idea" will go to the wall. In the realm of forced ideas he appears to place the attempts which have been and still are being made to utilise single-phase currents for the transmission of energy. Such attempts, abandoned fifteen years ago after considerable effort to develop the system, have recently been again forced to the front, because of the successful experience which has followed the use of polyphase currents.

The author considers that the efforts to build economic single-phase generators and motors, whose characteristics may be favourably compared with those of polyphase machines, have not been crowned with success, and he is of opinion that if single-phase currents are to be used successfully, it will be necessary for some new creative idea to be introduced, the effect of which shall be to eliminate the present disadvantages which appertain to single-phase systems. Whilst he looks with scepticism on the gigantic experiments which are to be conducted on the New York, New Haven and Hartford Railways, the experiments will be watched with the respect due to an enterprise of such magnitude.

Touching upon the want of agreement which exists in regard to the system best adapted for heavy electric traction, it is pointed out that, in the Simplon Tunnel scheme, three-phase currents will be used on the locomotives to haul the trains between Switzerland and Italy; in the New York Central and Hudson River Railroad direct current will be used; and, as mentioned above, in the New York, New Haven and Hartford Railroad single-phase current is to be used.

Whilst the utilisation of direct current at about 1,000 volts on railroad motors is based on well-established experience, the idea, associated with the name of Thury, of transmitting large powers by means of high-pressure direct current is classed in the category of those forced ideas which can only exist so long as they receive what is termed the hothouse treatment. Such ideas, says the author, cannot hold their own, though they persistently crop up like weeds which would fain take the place of useful vegetation.

Touching upon the influence which electrical engineering has had upon steam engineering, it is interesting to notice that, whereas the high speed of the dynamo forced engine-makers to design high-speed engines running at many times the speed which was usual before the era of Electrical Engineering, the tables have now been turned by the coming of the steam turbine, which has caused dynamo designers to design machines for speeds which at one time were never dreamt of.

Mr. Behrend concludes an interesting *résumé* of the development of the transmission of electrical energy by a prophetic guess, in which the wish is father to the thought, that some method will sooner or later be introduced for the mechanical generation of direct current without commutators or without a multiplicity of sliding contacts.

D

THE ELECTRICAL ENGINEERING PROFESSION.

By ERNEST T. WILLIAMS.

Twenty years ago an engineer with a knowledge of electricity was in a position to reap the benefits of a market in which the demand was greater than the supply. The natural result was that the electrical profession became the "Mecca" of aspiring parents for their brilliant (and otherwise) sons, and a large number of youths commenced an oft-times expensive training in the hope of reaping a future golden harvest. Many of those who entered in the earliest years have moderately realised their anticipations, but others coming later did not find the demand so great, and, though new appointments were constantly opening up with the extension of electrical application, the number of qualified men open for appointment continued to increase at a greater rate, until it can fairly be said that the prospects of a youth just finishing his training are not brilliant; we might ask if they are even good, or, compared with some other professions and most businesses, even reasonable. Undoubtedly in Great Britain the supply of qualified men is much greater than the demand, and yet there is an ever-increasing number of youths pouring into, and out of, the training colleges, until there is a glut on the market, and some of the most promising are at the outset of their career doomed to realise that the law of supply and demand is a grave factor in life, and that the chance of their attaining the positions which were to give some return for much sacrifice, labour, and expense involved in their training, is an ever-decreasing one. If such is the case to-day, what will it be 10 or 15 years hence, when the number of qualified electrical engineers will have increased by hundreds, perhaps thousands, whilst the wastage due to death, and to those who have left the profession, will be comparatively insignificant? It is to be hoped that by that time the tide will have turned, that unwary parents will have learned the true conditions, and that the influx of new men into the profession will be reduced to a normal healthy supply.

We might ask what is to become of those already launched into the profession, and of others who are entering it—do we realise that the great influx is likely to cheapen it, and cause comparatively good positions, which are obtained after years of work and experience, to be less remunerative and secure—and, lastly, can nothing be done to reduce the evils spoken of, and to raise the status of the profession to the level of those most recognised and honoured by the world?

One has but to read the letters which occasionally appear in the technical papers to realise that many young electrical engineers are experiencing the greatest difficulty in obtaining appointments at a bare living wage, and even when successful the prospects are not such as to justify marriage, with its immediate and prospective responsibilities. It would be well if many such were to consider the prospects of electrical engineers abroad. The writer hopes in a future article to deal more fully with the various aspects of life abroad; given fair prospects the question deserves every consideration. The business or commercial side of engineering might with advantage be looked into, especially when there is any evidence of good business capacity, or the question of taking up some other branch of engineering in which one's electrical knowledge and experience would be valuable, might be considered. In other words, and whilst fully recognising the value of consistency, it would be well for young engineers to realise that few men are able to run the course mapped out by them in their youth, and successful ones are often those who have availed themselves of the opportunities which have arisen, though these may not have been what were desired or had been planned, instead of waiting for just what they wanted to turn up. Even more might be done; if the opportunities do not appear to come to them, they must endeavour to make their own—if the river will not come to you, then you must go to the river.

There can be little doubt that the great supply of young engineers is to some extent due to the energy of technical training colleges and to electrical engineers or firms who take pupils.

No fault can be found with the taking of pupils when practised in reason—just the opposite; but can an engineer be said to be upholding his profession when he takes a far larger number of pupils than the concern of which he is the head can justify? It has not been an uncommon thing to see a small central station or a small works almost run by pupils, who not only pay premiums to the engineer or firm, but by their working at little or no salary are keeping other men out of positions they reasonably expect to obtain. Is this kind of thing honest, or just to the pupils themselves? They become pupils trusting in the good faith of the engineer that they may reap a reasonable return—is he promoting that end by his methods? We might pause and ask whether there is not a moral obligation on the authorities of a training college, or on an engineer, to endeavour to point out to a youth or his parents what the prospects are before he sets out on his career; they might by this lose something, but the gain to society and to the profession would be great.

It is not pleasant to think that many electrical engineers themselves have done much to cheapen the profession, but we fear this is the case. Some station engineers, for instance, have been so anxious to reduce their expenses another decimal point, or to make a few more pounds profit on the undertaking, that they have countenanced the payment of what might be called starvation wages to the qualified assistants who are helping them to bring about the desired results. Let it be made quite clear that every possible praise is due to the efforts to obtain economy when they can be justified, also it should not be lost sight of that the question of salaries is one over which some committees exercise entire control, often against the engineer's recommendations; but there is reason to think that many engineers themselves have been to blame for advocating low salaries, or for having allowed their continuance without protest. A little thought will show that this is a short-sighted policy, and in time must not only react on the profession generally but also on themselves.

We cannot pass this point without in justice recognising those engineers who have worked on entirely different lines, and there are not wanting signs which indicate that under some of our most respected engineers the assistants' salaries and positions are more in keeping with the training and experience required. It should not be lost sight of that an engineer who advocates the payment of reasonable salaries is not only loyal to himself, his assistants, and the profession, but also, to the greatest extent, to the undertaking he controls, as it is well known that good men are a great factor for efficiency, and if reasonably paid are more likely to remain with the undertaking, to its advantage—on the other hand, good men who are underpaid are unsettled and on the lookout for something better; this may partly account for the name electrical engineers have got for constantly moving about.

Finally, we might ask can nothing be done to raise the tone and status of the profession generally? Our great representative Institution is that of the Electrical Engineers and largely upon it depend any results. We may feel justly proud of the Institution and of its work, and, representing a new profession, it has opened wide its arms and embraced—wisely we think—many who would under other circumstances not be entitled to membership. This openness, on the other hand, has allowed many to flow in who are not a credit to the profession; might it not be pertinent to ask whether the time has not arrived when a higher standard should be fixed, so that membership of the Institution may stand for some guarantee that the holder is a fully qualified electrical engineer and a member of the profession? It is not suggested that any present member should be voted out, but rather that new entries should be so regulated as to make association with the Institution something to be worked for and sought after.

The electrical technical journals have done much in the past for the profession; may we not hope that though so crowded with technical matter they will be able to do even more in the future? The influence and power of the Press is impossible to estimate, and if its whole weight were used to raise the tone and status of the profession, the result would be invaluable. Lastly, we have electrical engineers themselves—each one should cultivate that love for, and loyalty to, his profession, which is seen in some other professions; all respect is due to those who have been, and are, working

for this end. As a profession we have grown quickly, and believe we are healthy and strong—now we want consolidating, trimming into shape, and to be imbued with that "esprit de corps" and loyalty, which in a nation is patriotism, and attains that which, without it, would be impossible.

ETHICS OF THE LOWEST TENDER.

By IAN GORACH.

Some time ago the writer, in criticising an article in this journal, incidentally referred to the morality of invariably accepting the lowest tender; and as this has a distinct interest for every business man, he has ventured to set down a few ethical considerations relating to tenders in general.

It will not, presumably, be denied that the primary object of inviting competitive tenders for certain work is to get that work carried out successfully for the cheapest price consistent with the specified conditions—in short, to obtain the best possible work for the least possible cost. This is a thoroughly praiseworthy aim, which no sensible person can or will object to.

How does this work out in actual practice?

The buyer, or his technical adviser, issues a specification purporting to show, *inter alia*:—

(*a*) The extent of work to be done.

(*b*) The manner in which the said work is to be carried out.

(*c*) The materials to be employed in doing so.

Assuming such to be a *bonâ fide* specification, it naturally follows that:—

(*a*) As far as the buyer can reasonably be expected to know, the whole work is specified, and consequently the offerer is entitled to consider only such work as is actually included in the specification.

(*b*) The manner in which the work is to be carried out having been specified indicates a desire on the buyer's part to have it so, and hence the offerer is in duty bound to quote for carrying it out in the required manner. This in no way debars him from submitting an additional and alternative offer for carrying out the work in any way which he may think more suitable.

(*c*) Similarly the fact of the grades or makes of material being specified indicates a presumably reasoned decision on the buyer's part to have such, and binds the offerer to quote *only* for such, unless he *distinctly indicates* in his tender wherein he has differed from the specification.

These statements being practically axiomatic require no proof; unfortunately, the principles laid down in them are too often ignored.

The next question which arises is why such alarming differences appear in tenders; and this is due to many causes which may be classified as under:—

Faults in the specification.

Faults in the offerer.

Faults in the inspecting engineer.

I. Faults in the specification.—These are very many in the majority of cases, and, although "to err is human," yet it becomes consulting engineers, who are supposed to be specialists, to take every precaution against errors appearing in their specifications.

The most common errors are:—

(*a*) The extent of work to be done is not specified, but a vague generalisation is given, placing the onus of discovering its full extent on the offerer's shoulders.

(*b*) The method of carrying out the work is improperly or loosely stated or omitted entirely, and each offerer allowed to be a law unto himself.

(*c*) The quality of the materials to be used is left an open question; or a standard quality is coupled with the hackneyed phrase, "or other approved make"; or first-class and third-class makes may be alike mentioned in an indefinite manner.

(*d*) In wiring contracts in particular the positions of points, switches, fuseboards, and even main switchboards, are left in a glorious uncertainty.

This laxity may be due to the pardonable ignorance of the buyer or his technical adviser; to simple carelessness; or to wilful-design. The first two of these may be counteracted by adding a schedule to the specification wherein the offerer must detail what, and what make he is quoting for. But the third reason is the expedient of the "sharp" buyer, who hopes thereby to obtain an advantage over the offerers. Where such can be proved to exist, it ought to be countered by "sharp" treatment.

That such specification faults lead to great price differences goes without saying.

One firm may go over the work with both eyes open, and so discover all that requires to be done, while a rival firm by using smoked glass spectacles sees no more than the least possible; one may quote for the highest grade material, another quotes for the lowest; one firm considers the buyer's interest and convenience, another considers only its own. How then can a buyer ignorant of these points adjudicate justly between tenders if he looks only at the price, because it is quite conceivable that the highest priced tender may in sober reality be the lowest, paradoxically speaking. Hence arise the two following ethical considerations:—Is it just to the offerers to ask them to quote on an indefinite specification? Is it just to the buyer to decide on the lowest tender without a due knowledge of what is being tendered for?

II. The faults on the Offerer's side.—Neglecting any faults or errors which may be due to the errors of specification already dealt with, the errors on the offerer's side are due to

(*a*) Ignorance.

(*b*) Error of judgment.

(*c*) Wilful design.

(*d*) The desire for an advertisement.

(*a*) and (*b*) The ridiculous and indefensible system of quoting for electric wiring work on a price "per wiring point," has a great deal to do with the first and a great deal more with the second of these faults.

Because "points" may be 5 or 50 ft. apart, and may consist of one 8-c.p. lamp or of 10 to 20 16-c.p. ones; and if the offerer has never previously had experience of a similar contract, then his very ignorance of the time and material involved in its execution render his offer valueless as a safe criterion of price. On the other hand, even with an experienced offerer, there is always the chance of an error of judgment, or even of a clerical error upsetting the final calculations very materially.

Here the consultant's knowledge of the probable cost of the contract should take effect by weeding out any offers obviously too high or too low. How often is this done?

(*c*) An offerer may wilfully send in a tender so low in price that the contract could never pay him were he made to comply with the specified conditions; but he trusts, after securing the contract, to be allowed to depart in many essential points from the specification, and to pile up a bill for "extras" far exceeding, perhaps, the price quoted originally by the highest tenderer. The only way to checkmate such is to see that the specified conditions are fulfilled in the spirit as well as the letter.

(*d*) How often do we hear that such a contract has been taken as an advertisement for the contractor. Such a method of advertising does not pay the contractor, neither does it finally pay the buyer. For, notwithstanding the most honest intentions of the contractor at starting the work, it is quite against human nature to look on and see the cost exceeding the estimated price without making an endeavour at retrenchment by scamping the work.

III. The faults which may be laid at the door of the inspecting engineer are also many, whether that inspecting engineer be the consultant or an assistant. The most important, however, is that he does not insist on obtaining the specified material, but allows inferior grades to be substituted. This leaves a very wide door for unfair competition, and is a decided hardship on the honest contractor.

At the same time, the writer knows the difficult position in which consultants are very often placed by unreasoning and ignorant committees, and sympathises with them. In many cases their recommendations are overruled or ignored and ridiculous tenders accepted in opposition to their expert opinion, and then to crown all, permission is refused to install a resident inspector on the contract, in order to see the specified conditions carried out. Such treatment of a —presumably—technical expert is most insulting and humiliating.

The writer has known of contracts being placed with firms whose tenders were less than the cost of material alone, exclusive of labour; of cases where the accepted offer was only 50 per cent. of the consultant's approximate estimate; of cases where the accepted tender was only one-half of the next higher and one-third of the highest tender; and all these for important public buildings and institutions. In all these cases committees entrusted with the duty of spending the ratepayers' money to the best advantage accepted the lowest tenders in spite of their consultants. Now, where is the morality of any public body taking such a course; a course calculated to do one (or both) of two things, namely, to suck the life's blood out of the unfortunate contractor, or to give the ratepayers a finished job scrimped and scamped in every detail, a job which will give trouble from the first day, and ultimately cost more than if a reasonable tender had been accepted in the first instance.

Is this not the usual result of the "lowest tender" craze, and is it not driving the engineer out of the contracting business and allowing it to fall into the hands of the jerry wireman and the stuck gasfitter?

In conclusion, the writer has very little hope that the foregoing remarks will do any real service in making specifications more accurate, or consultants stricter, or tenders more uniform. The average Britisher likes to be preached at, and to be asked to reform his ways, but in his characteristic manner refuses to do so, and hopes that, as did his forbears, so may he, "muddle" through.

OVERHEAD DISTRIBUTION AT EBBW VALE.

This installation, which was finished in February last, is chiefly remarkable for its size, there being 20 miles of network covering a large and straggling area, which includes Beaufort in the north; Victoria, Waun-Llwyd and Cwm in the south, with Ebbw Vale as the chief and central district.

Most of the routes are of a decidedly circuitous nature; indeed, there is hardly a total of two miles of lineable runs in the whole system; in addition to this it was necessary to employ long spans, the 70 yd. B. of T. limit being often and well maintained. Notwithstanding this, the B. of T. regulations were carefully adherred to, a circumstance which often rendered the construction a difficult task.

The system is a three-wire one with 500 volts across the outers, energy being supplied from the Ebbw Vale Steel Co.'s plant. The poles employed are creosoted wood, topped with turned finials in the main streets, and with ordinary metal roofs in the less important places. The arms are of steel channel, attached by means of back straps, a method which proved neat and efficient. "Helsby" insulators are used throughout; of the two straight line types employed, one is similar to, though more robust than the P.O. pattern, the other has a wider shed and deeper slot; the shackle insulator is a double shed pattern of strong design. The conductors are of four sizes: 000, 0, 4 and 8 B and S gauge, the first being for feeder work, and the last for neutral wires on lighter runs. The live wires on double runs are 20 in. apart; the lower neutral wires are 36 in. apart, these having a cross bond 6 ft. from either side of every pole.

There are no joints in the spans, these being effected between shackle insulators at poles. A great deal of care was exercised in arranging the cross strains to balance on the principal poles, and thus to avoid awkward staying. Owing to the long spans and numerous angles, the wire regulation had to be most carefully adjusted. Small diagram cards of the principal pole connections were issued to the foremen; these were numbered, and corresponded with numbers on section plans issued during the course of the work. Polarity diagrams, guard span diagrams, and similar records were carefully kept, and found to be of use during the construction, and subsequently on completion. The system successfully stood the specified 1,000-volt pressure test.

It will be understood by those who have undertaken similar work, that much time was spent in obtaining wayleaves; the G.P.O. and railway companies being specially exacting in their requirements.

Private consumers are generally fed on to a bracket attached under the eaves, a lead-covered cable being brought through the upper storey wall or window, or down the wall and through a fanlight into the hall. Where possible, the house service lines are taken from the poles, to avoid sagging the wires; in some instances, several consumers are supplied from one tapping, the wires being carried across the face of the buildings. It may be added that both the public and private lighting is proving extremely satisfactory, the latter load increasing to an extent that promises a fair return on the outlay.

Mr. Reginald P. Wilson has acted as consulting engineer to the District Council for the entire scheme, and Mr. W. Horsfall as resident engineer for the Council. The aerial work was carried out by the British Insulated and Helsby Cables, Ltd., some 663 poles, 3,800 insulators and 150,000 yards of wire being employed.

ALUMINIUM COILS.

By FELIX SINGER.

A new electrical invention has been patented under No. 10,457/06 in England, which, owing to its technical and material advantages, may become of considerable importance to the electrical industry.

The well-known property of aluminium to become covered with a layer of oxide, even at ordinary temperatures, which, although hardly noticeable, offers such a resistance to the electric current that a potential difference of about 0·5 volt is required in order to break it down, is being utilised (in accordance with the above-mentioned patent of a German electrician, Mr. Robert Hopfelt) for winding magnet coils, solenoids, &c., with *bare* aluminium wire, the turns of which touch each other in the same manner as if the wire were specially insulated. It is clear that only the single layers of such a coil need to be insulated from each other by intermediate layers, as the potential difference between the same is greater than that between adjacent turns.

Theoretical and practical tests, made by prominent authorities, have fully proved, amongst other things, the advantages claimed for this invention, viz.:—

1. An economy in cost of 40-50 per cent., as compared with insulated copper wires as hitherto used.

2. An economy of about 55 per cent. in weight.

3. A far greater safety in operation for many purposes; for instance, in damp places or places filled with gas, for electric railways, crane motors, &c.

As aluminium oxide does not possess the property of coming off in thin layers, like the oxides of all other metals used for electric lines, for instance, copper, iron, &c., it is claimed that this natural insulation is superior to all other insulations, such as india-rubber, silk, cotton, &c., also in regard to its durability and constancy at a high temperature. Aluminium coils will practically stand a temperature of more than 100° C., provided the body of the coil and the intermediate layers be made of incombustible material.

Experiments made in the United States for a number of years with aluminium wires for overhead lines, have shown that the objection raised by some parties, that the oxidation of aluminium wire increases constantly during use, has proved unfounded. On the contrary, Mr. J. Parke, reading a paper some months ago before the "Canadian Electrical Society," stated that according to American experience the durability of an overhead line of aluminium wires was greater than that of one of copper wires.

Owing to the low conductivity of aluminium (which bears a ratio to that of copper wire of 1 : 1·7), the question as to the space required in using aluminium wire is of the greatest importance, especially for the construction of electrical machines. Calculations made in this direction have shown that aluminium wire up to a diameter of 1·3—1·5 mm. does not require a greater space than round copper wire covered with a double layer of silk or cotton, in spite of its

greater volume. In order to save space when using larger wires, square copper wires are used instead of round ones, as in the construction of electric machines of large output.

When calculating aluminium coils, it is also to be noted that the temperature coefficient of resistance of aluminium is only 0·36, *i.e.*, about 10 per cent. less than that of copper wire. Besides, aluminium coils will cool down better than coils of insulated copper wire. Many tests have shown that, in order to attain the same temperature, an aluminium coil can stand an overload of about 20 per cent. more than a copper wire coil of the same capacity. Considering these facts, when calculating aluminium coils, the conductivity, as compared with that of copper, is to be taken at 1 : 1·5.

These qualities of the aluminium coils, together with the incombustibility of the insulation, will probably also produce an alteration of the standards for dynamos, motors, &c., in that higher temperatures will be permitted for coils of aluminium wire.

The following table offers an exact and detailed comparison between coils of various sizes of insulated copper and bare aluminium wire in regard to the dimensions, space, weight, resistances, price and economy :—

	Cu.	Al.	Cu.	Al.	Cu.	Al.	Cu.	Al.	Cu.	Al.	Field winding of a generator of 400 kw., 480 volts, 110 r.p.m., 10 coils Cu. each.	Field winding of a generator of 400 kw., 480 volts, 110 r.p.m., 10 coils Al. each
Interior diameter of the coil, mm.	20	20	20	20	20	20	100	100	150	150	420	420
Exterior diameter of the coil, mm.	45	45	45	45	45	45	200	200	250	250	550	550
Breadth of the coil, mm.	80	80	80	80	80	80	70	70	100	100	350	350
Depth of the winding, mm. ...	11	12	11	8	11½	12	43·5	42	49	46	65	60
Diameter of the bare wire, mm. ...	0·40	} 0·5	0·20	} 0·25	2	} 2·3	1·5	} 1·6	2·5	} 2·7	3·7	} 4 □
Diameter of the insulated wire, mm.	0·53 d.s.c.		0·30 d.s.c.		2·3 d.c.c.		1·8 d.c.c.	□	2·9 d.c.c.	□	4·2 d.c.c.	
Number of turns	3,170	3,200	9,600	9,600	170	170	1,026	1,032	578	575	1,230	1,232
Length of the wire, m.	306	320	930	845	16·6	16·6	480	460	363	353	1,750	1,740
Resistance, cold, ω	42·4	46	510	485	0·092	0·110	4·75	4·90	1·29	1·34	2·76	3·16
Resistance, warm, ω	52·5	53	630	550	0·140	0·123	5·8	5·6	1·60	1·52	3·6	3·6
Weight of the insulated wire, lb.	0·77	0·38	0·57	0·25	1·03	0·41	16·04	7·22	32·30	15·64	3,510	1,526 } 10 coils
Cost of the wire (Al. with intermediate layers), shillings ...	2/7	-/11	3/-	-/8½	1/7	-/10	23/6	14/10	50/6	29/10	5,140	2,980 } 10 coils
Economy of weight, per cent. ...	50		55		60		55		51		55	
Economy of price, per cent. ...	60		67		58		37		42		42	

As to the manufacture of the aluminium coils, the process is very simple. Coils mounted on spools are wound in the usual manner, with the only difference that intermediate layers are placed between the single layers (not turns), which should consist of hygroscopic material, such as asbestos or common hard paper or shirting tape of very small thickness (0·1—0·4 mm.). It is to be especially noted that, in order to prevent the passage of current from one layer to another, the intermediate layers should be a few millimetres wider than the winding of the coil, so as to overlap the end windings by 1 or 2 mm. on each side.

If the windings are made on formers, care should be taken that, when removing the coil from the former, the intermediate layers do not become displaced. For this reason it is advisable either to wind the coils in boxes (as in the case of coils of large machines) or to place them on binders of suitable length and to twist them together before removing the coil from the former.

It has been shown that the layer of oxide, forming the insulation of the wire (aluminium oxide being nothing else than argillaceous earth, *i.e.*, the raw material of porcelain) is increased by the action of dampness upon the coil in such a manner that several hundred volts are sometimes required in order to break down the insulating layer. It appears from this that coils used in the open air, such as field coils for electric railway or crane motors, coils of field telegraphs, electric bells, &c., are not affected by the dampness of the air or soil, if made from bare aluminium wire, but that such coils will, on the contrary, improve the more they are exposed to dampness.

For the purpose of bifilar windings, for shunts of dynamos or other (large) coils with high inductive pressures, it will be useful to increase the layer of the natural oxide. This can be done by impregnating the coil with water and sending a current through it, provided the body of the coil consists of waterproof material. The polarisation of the aluminium wire can also be increased by soaking the wound coil (or a number of coils in series) in an electrolytic bath with sodium hydroxide or the like (the coil being attached to the +, and a lump of lead, or the like, to the − pole) for some minutes, and by drying it thereafter with a strong electric current, if possible, until 100° C. is attained.

In the case of alternating current, the insulating layer is produced more slowly, so that every alternating-current coil should be subjected to direct current for about 15 minutes, until heated to about 100°-120° C., or soaked as mentioned above.

It has hitherto proved to be a difficult process to solder aluminium wire, so that for each coil a single wire has had to be used. The inventor has succeeded in devising a simple and safe soldering (welding) process for aluminium wires, in which a direct union of aluminium with aluminium will be made (autogenous-welding). No special apparatus are necessary for the use of this process; only a burner flame of acetylene, coal, spirit, or oxygen gas, and a fluid for the purpose of dissolving the oxide coating, that is, for the reduction of the alumina, are required.

The invention is the property of a German company (Syndicate for Aluminium Coils, Ltd., of Berlin), which is exploiting the invention only by granting licences for the use of the patent rights in the various countries. The author is informed that on the Continent the new process is already adopted for all such methods of using coils, for which, so far, insulated copper wire has been employed, *i.e.*, for all purposes of heavy or low currents, as for coils of telephones and telephone relays, telegraph apparatus, bells, indicators, instruments, dynamos, motors, tramway motors, controllers, electricity meters, rheostats, arc lamps, release coils of circuit breakers, lifts, &c.

THE ENGINEERING CONFERENCE.

(*Continued from page* 114.)

The Use of Pneumatic Tools in Workshops.

This subject was introduced in Section III (Machinery) on Thursday, June 20th, by Mr. Charles Palmer Whitcombe, M.Inst.C.E., who gives prominence to the following features in a short paper: "Ample margin should be allowed in fixing the capacity of the compressor, as it is impossible to foresee all future requirements, and direct coupling to a steam engine or electric motor is preferable to a belt drive. When the air pressure exceeds 80 lb. compound air cylinders with an intercooler will effect an appreciable saving. Air mains should be of liberal diameter, thus allowing storage capacity and minimising frictional losses. Separate receivers should be located near the principal points of consumption, and water-traps and drip-cocks should be provided in convenient positions."

The speeds of performing various operations by handwork and pneumatic tools are next compared, the average speed by compressed air coming out at 3·4 times faster than the

older methods, for heavy chipping, caulking, drilling, rimering and riveting, the latter process only requiring two men with a pneumatic tool as against three for hand riveting. A leading firm is stated to possess figures showing a weekly saving of £2 in wages for every £1 of running cost of the pneumatic plant, capital charges being included in this analysis. The demand for pneumatic tools is said to be steadily increasing, though not so rapidly in the United Kingdom as in America and Germany.

Compressed air is the only available medium for the operation of portable tools for riveting, caulking, and chipping, but no manufacturing engineer whose works were provided with electric current would now lay down compressing plant for drilling, tapping, and rimering. Portable electric drills have been much improved of late years, and although they still require more careful usage than their pneumatic competitors, and the cost of maintenance is considerably higher, these advantages are more than counterbalanced by the saving in power. Tests show us that pneumatic drills take approximately four times as much power to drive them as is the case with electric tools—that is, if we refer back to the prime mover actuating the compressor or dynamo respectively. This feature has a very considerable effect upon the first cost of the portable drilling plant, as, even supposing that a special generating plant has to be installed to provide electric current for portable drills, the power required will only be one quarter of that necessary for air compressing. This comparatively low first cost is also reflected in the running costs, which are low as regards both capital charges and fuel consumption. A further advantage pertaining to the use of electric current consists in the possibility of holding the drill stands in position by magnetic attraction, and for some lines of work a considerable saving in time follows the use of this clamping device.

We shall quite expect to find electric portable drills ousting the pneumatic rivals in future, and it is not impossible that portable electric tools may yet be invented for riveting, caulking and chipping, which will successfully compete with apparatus driven by compressed air.

Modern Applications of Electricity to Mines.

In Section VII (Applications of Electricity), on Friday, June 21st, Mr. C. P. Sparks read a paper on "Modern Applications of Electricity to Mines." It contained certain facts and figures relating to the Powell Duffryn Co.'s mines, with inferences drawn from them, and laid down the conditions which govern the cost of electric power and the economies resulting from its use.

In this paper Mr. C. P. Sparks once again draws attention to the many advantages to be derived from the adoption of electric driving of machinery in collieries. This country is the oldest coalfield in the world, and one may say the cream has been taken off long ago; in order, therefore, to keep the industry going, the colliery owner must reduce his costs, and it is now fairly generally acknowledged that one way to attain this end is to adopt electricity, and to transmit the power as close to its work as circumstances will permit. Whilst we do not altogether agree with everything Mr. Sparks says, as the paper is based on an individual example of the application of electricity to a group of collieries, which shows results that it would be impossible to obtain in other districts—though, on the other hand, it is only fair to add, other collieries may be so favourably situated as to produce even better results—yet we think that by now every mining engineer and colliery manager will agree with him that "no other system has equal flexibility in distribution, or is so well adapted to meet every form of drive above or below ground."

There is again no doubt that the mining engineer will readily admit that the principal economies resulting from the adoption of electricity are "small loss in transmission," and the "high efficiency of the electric motor," as compared with other motors, actuated by either oil, compressed air, or steam, when applied underground. Mr. Sparks also claims "reduced stand-by charges" and "the lower capital cost of producing and transmitting electricity." As regards the former, it all depends upon what is included in the "stand-by charges"—the circumstances under which the charge is necessary are usually too vague and too varied at individual collieries to entitle the claim to be considered a general one; as to the latter, this is a most controversial point, and it is open to question whether electrical engineers are acting in the best interests of their clients, or of the electrical engineering profession generally, in repeatedly making this claim. Good electrical machinery is not cheap any more than good steam plant; when it comes to the capital cost of a large central generating station this is anything but low, and we really can see no justification for making such a claim. It is purely a case of where a colliery owner must spend money in order to save it, and by adopting electricity he can recover the money so spent much more quickly than by any other system of power transmission owing to the greater economy and flexibility of electrical transmission, which is probably experienced in no other industry so much as in mining. Further, it should not be forgotten that, in the event of the eight-hours proposition becoming law, the adoption of electrically-driven machines may do much to prevent the reduction of output, so much feared by the colliery proprietors.

As to the cost of generating electricity, this principally depends upon the load factor, though it is, of course, affected, as Mr. Sparks says, by the size of the undertaking, capital outlay, and cost of fuel, the latter having a most important bearing where mines have to purchase coal, such as ironstone and shale mines, but obviously not being so important in collieries consuming worthless slack, or where the steam is generated by gas from coke ovens. The load factor, however, is the principal item demanding attention, and very much can be done by so arranging the work over the 24 hours as to get a high load factor; for instance, coal-cutting and pumping may be arranged for a night load when the other machinery is stopped. We admit that, at present, at very many collieries coal-cutting forms only a small proportion of the total load, and the enormous possibilities of coal-cutting are, in fact, not yet fully realised, but at some collieries the pumping is very considerable, and we certainly think in many cases it would pay to scrap steam pumping plants, form gathering reservoirs and install motor-driven centrifugal pumps, to clear out the water at night. In the example quoted by Mr. Sparks, the *total cost* per unit is 0·35d. with an average load factor of 36 per cent., which compares very favourably indeed with the price per unit that can be offered by any electric supply company, and further, it must be borne in mind that this cost includes coal at 5s. per ton. What, then, would be the cost in the case of collieries generating steam from the waste gases of coke ovens? We venture to think there ought to be little difficulty in such a case in generating electricity at ¼d. per unit, or in the case of a large plant even less.

Haulage is, without doubt, the most important application of electric driving, and will be very largely increased in the near future, and there is every reason to hope that horse haulage will become a thing of the past. Next to human labour, horse haulage is the most costly, and there is no reason why small electric haulages should not displace, at any rate, the heavy horses, some thousands of which are employed in the mines of this country. We will go further and say that in many cases small ponies could be displaced with advantage, as this would not only get over a difficulty experienced in finding boy labour, but the work would proceed more quickly, the output would be enhanced, and both the owner and the consumer would reap the benefit.

Coming to electric winding, about which the last word has not yet been said, we think that in spite of the tremendous opposition on the part of some engineers, it is slowly and gradually making headway. It is an important and serious responsibility to change a steam-driven winder to an electric one, and we think the success of this application of electric driving lies not so much in the electrical portion, as in the design of the mechanical part; mistakes that have been made in the past have been due to designing the electrical portion to suit the already installed mechanical portion, with the result that it is very like attaching the engine of an automobile to a brewer's dray instead of the horse.

Mr. Sparks's paper is a useful contribution on the subject, not the least useful being the information regarding costs

and efficiencies, as these form a standard upon which to base future estimates and to attempt to improve upon them; and it is important to note that British manufacturers of centrifugal pumping machinery are quite able to hold their own against their foreign competitors, as the two turbine pumps by Messrs. Simpson, each capable of delivering 1,300 gallons per minute, against 1,650 ft. head, driven by Westinghouse 3,000-volt 50-period motors, with a guaranteed efficiency from input at motor terminals to output of water at the surface of 69 per cent., will be hard to beat. With reference to the motors driving the haulage gears, it is also interesting to note that in the case of the large 300-B.H.P. motor, this drives through a single reduction gear, which is a step in the right direction: too much has been attempted in the past to reduce the first cost of the electrical portion by putting in small high-speed motors with a train of reduction gearing at the expense of efficiency and economy, and, what is worse, earning a bad reputation for electric driving. "What is worth doing, is worth doing well" is an old saw, but it is worth remembering in the application of electricity to mining.

Discussion.

Mr. Hann opened the debate, explaining that steam pumping involved long, and therefore wasteful, steam pipes, since the pumps were underground. There was not shaft room to place them on the surface.

Prof. Redmayne took up the cudgels for compressed-air transmission of power in mines, stating that its efficiency was as high as 75 per cent., and compressed-air motors were increasingly used in coal cutting, displacing electric motors. Ease of handling was more important than efficiency. Electric winding, he said, was in operation in this country. The lack of a good system, not the capital cost, prevented its extension. Winding was a peculiar operation, involving heavy loads, rapid acceleration, high speed and a sudden stop. With deeper mining, the electrical method would be increasingly used, if only for the handiness of it, which was its prime advantage.

Mr. Davey, while acknowledging the advantages of the flexibility of electric working, dissented from the generalisation that what was good in one mine was good in all. Local circumstances and the character of the mine, whether metalliferous or coal, made a great difference. He quarrelled with the author's definition of overall efficiency, saying that, for a pump, it should be measured as the ratio between the power of the engine on the surface and that represented by the water discharged.

Mr. Patchell said that Mr. Davey's complaint was that, having a good thing, he wanted more of it. Electricity was not a patent medicine, to cure all complaints, and its economic application depended on the position of the motors and their hours of use. Thus he had 2,900 H.P. of haulages which would only give a 5 per cent. load factor. It did pay, in spite of his compressed-air friends, to run haulages by electricity; and having to generate current, it was worth while to sacrifice on the fans, and to run them electrically to get a long load on the plant. He wished Mr. Hann and Mr. Sparks had been able to give the quantity of small coal used in the pits before and after the introduction of electricity. Mr. Sparks might be understood to imply that centrifugal pumps could always replace reciprocating pumps; but they could not be taken, as some people took steam turbines, as good for everything. If a man had the misfortune to have a great deal of water in his mine, he was in a position to use a centrifugal pump efficiently. He would like to ask whether the change from the slip-ring type to the squirrel-cage type was to gain experience, or the result of experience. Mr. Sparks had said nothing about the rating of motors; of course, in a short paper he could not give everything, but it would be interesting to hear how he rated his haulage motors. Electrical work must be thoroughly well done, and thoroughly looked after, for whenever one had to speak on electricity in mines one had some fresh accident in mind. Quite lately electricity had been put into a pit, and the earthing done on a girder built intoa stone wall.

Mr. Peck (Westinghouse Co.) said the electric business in mines was growing, though the majority of coal-cutters were still driven by compressed air. The one disputed application was winding. As to frequency, 25 and 50 were the standards, and 25 was, he thought, best for mining work.

Mr. H. Mavor thought that to say that for coal-cutting compressed air was winning the day against electricity was too general a statement. On the whole, electric cutting was becoming the favourite, save in fiery mines where the risk, not from the motors, but from the severing of a cable, was serious. Conveyors and coal-cutting machinery had revolutionised the methods of mining, sometimes saving as much as 2s. a ton on the output. He had an uneasy feeling respecting the efficiency of 65 per cent. for centrifugal pumps, for that implied a 90 per cent. efficiency at each stage.

Dr. Herzfeld, referring to the reduction of space by the use of centrifugal pumps, cited a case where the owners had given up a water-logged mine and had afterwards cleared it by this means. He described the station and apparatus in detail, the voltage, the squirrel-cage motors, "the generating station *of the rotating type*," switchboard and equipment. His example showed that electricity would tackle problems that could not be tackled in any other way.

Major Thompson spoke of an efficiency of 65 per cent. as a test efficiency, and of spending an extra £6,000 a year for electricity.

The Chairman (Col. Crompton) called attention to the great diversity in the load factors.

Mr. Sparks, in reply, apologised for not having given more figures in a note. Capital cost was the crux of the question. He agreed with Mr. Davey that local circumstances must be taken into account, but he was satisfied that his criticism on the cost per horse-power was founded on a misunderstanding. He was sorry he was not at liberty to give Mr. Patchell the figures respecting small coal, but he could say that it meant a very substantial saving. The use of centrifugal pumps was a question of the quantity of water. There was no difficulty in starting the squirrel-cage motors with the pump valves shut. A frequency of 25 would be all right where large slow-speed motors came in, but, personally, he was in favour of a 50 frequency. *Pace* Mr. Mavor, he *did* get a 65 per cent. efficiency under test.

This discussion concluded the work of the section.

(To be continued.)

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Length of Notice to Leave.

Recently, when applying for appointments as shift engineer or assistant, the question of how soon I could enter upon duties has come up.

At my present appointment I am expected to give four weeks' notice, but I find that most advertisers are not prepared to wait beyond a week or a fortnight. Thus, owing to my being unable to start soon enough, I have had to give up several posts I have been offered.

I feel that I am not alone in this difficulty, and should be glad to hear through the medium of your columns how others have fared, and if something could not be done to bring about a uniformity of length of notice among central station employés according to position.

Aspirant.

July 20th, 1907.

[I.M.E.A. Convention.—A letter from Mr. H. R. Burnett, in reply to our observations of last week, was received too late for inclusion in this issue. It will appear in our next.—Eds. E.R.]

Electro-magnetic Driving Clutches.—"Inquirer" asks for the names and addresses of some makers of electro-magnetic friction clutches, with a description of the types of clutch made.

LEGAL.

Petition for Revocation of Patent.

Mr. Justice Parker in the Chancery Division on Monday, commenced the hearing of a petition for the revocation of letters patent, No. 14,006 of 1903, granted to J. N. Alsop.

Mr. Cripps, K.C., on behalf of the owners of the patent, said it was for a process of bleaching or ageing flour, which was of great importance and commercial value, it being in use in some 1,200 mills, 60 or 70 of which were in this country. He thought the fight would not be as to utility or commercial value, but whether at the time the patent was brought out, there was a patentable subject matter entitling them to the benefit of the grant. The process consisted of subjecting flour to the action of air which had previously been subjected to the action of an arc or flame of electricity. The result of so treating the air, was to produce a gaseous medium which bleached or whitened the flour. In the old days millers had to keep their flour for months, but by this process it became prematurely aged, and could be used at once. The patentee, who was an electrical engineer, was the first to subject flour to the action of a gaseous medium produced generally by the action of an arc or flame of electricity, and he issued at the same time a practical method or apparatus by which it could be carried out, and the apparatus itself was a patentable novelty. There was some doubt as to what the gaseous medium was, but no gaseous medium had been before produced, which, in its action on flour, had the same result. The main feature of the invention as regarded the apparatus seemed to be that a comparatively low potential was used. By this the risk was run of the arc being broken as the electrodes were separated when they got a certain distance apart. As they got apart there was further resistance for the arc to get across.

Mr. Walter, K.C. (for the petitioners): The voltage is 500. The ordinary arc voltage is 50.

Mr. Cripps said he was going to compare it with machines of 5,000 to 10,000 voltage. To counteract the tendency of the arc to

break, an induction coil was employed, the effect of which was to increase the current just when it was wanted to be increased, and to allow the continuity of the arc, even at a low potential. On the other hand, when the two electrodes were together, a short-circuit was produced, the effect of which was to re-charge the coil. The coil was therefore re-charged and utilised automatically, and even with this low voltage they got an automatic continuity of the arcs which was essential for the working of the process, and, as a matter of fact, it worked with perfect success and without any practical difficulty at all. The patent was attacked on the ground of prior publication and invention, and the petitioners, Messrs. Andrews & Andrews, relied on a patent granted to them for a chemical process in 1901 and on the specification of MacDougall.

Evidence was given on behalf of the respondent by Mr. SWINBURNE, who said that the gaseous mediums produced by the Andrews and MacDougall processes were not the same as that prescribed and produced under the Alsop patent. He could not say in what way they differed chemically, but their effects were different.

The hearing was adjourned.

TRAM PASSENGER'S CLAIM.

AT the Leeds Assizes, on 17th inst., Mrs. Hannah Andrews was awarded £500 as damages for personal injuries sustained while travelling on August 13th on the line work by the Imperial Tramways Co., Ltd., between Middlesbrough, Thornaby and Stockton. It was stated that plaintiff was attempting to alight when she was suddenly jerked off the car.

LYNCH *v.* MACARTNEY, MCELROY & CO.

IN the Court of Appeal, consisting of the Master of the Rolls, Sir Gorell Barnes and Lord Justice Kennedy, on Monday, judgment was delivered in this case on the application of the defendants for judgment or a new trial on appeal from verdict and judgment at the trial before Mr. Justice Bigham and a common jury.

In this case the plaintiff brought action against the defendants to recover damages for an alleged libellous advertisement which was published in a Maltese newspaper, and the trial resulted in a verdict for the plaintiff for £250 damages. The facts of the case have been previously fully reported.

Lord Justice KENNEDY, who read the judgment of the Court, said they had come to the conclusion that the learned Judge was right in leaving the question of libel or no libel to the jury, but they were clearly of opinion that the damages awarded by the jury were grossly excessive. There was no evidence of actual malice on the part of the defendants, and the plaintiff did not pretend that there was actual damage. The alleged libel was only published in one newspaper in Malta where the plaintiff neither resided nor had any occupation. In these circumstances the case must go down for a new trial.

Mr. MCCALL, K.C., subsequently stated that to avoid the expense of a new trial he had on behalf of the plaintiff agreed to accept £50 in settlement, and the costs of the trial, there being no costs of the appeal.

The MASTER of the ROLLS said he thought the arrangement a wise one.

PARLIAMENTARY.

Glasgow Corporation Bill.—The Omnibus Bill of the Glasgow Corporation, which, amongst other things, gives powers to the Corporation to construct new tramways, was before the Police and Sanitary Committee on Wednesday and Friday last week. Mr. R. Graham, chairman of the Parliamentary Committee of the Corporation, explained that power was asked to construct certain new tramways outside the city, and in respect of them the consents of the burghs of Partick, Clydebank and Rutherglen had been obtained. Mr. Dalrymple, general manager of the tramways, said the Corporation asked for power to spend £50,000 on tramways. The estimates before the Committee were for £41,000, but this was merely for construction, and the balance would be for equipment, including the provision of cars. The Chairman said they must be supplied with further details of the proposed expenditure of the balance. On the Committee assembling on Friday, the sitting was occupied with the question of sewerage estimates, and a rather heated discussion took place with regard to evidence given on this point. The Committee therefore adjourned without dealing with the tramway estimates.

Electricians in the Royal Navy.—Mr. Alden, in the Parliamentary papers, asks the Secretary to the Admiralty what is the distinguishing badge worn by electricians in His Majesty's Navy; what are their special duties apart from those usually performed by leading torpedo men in ships and vessels; are candidates for these positions required to present indentures of apprenticeship to such special work; and, if not, what are the qualifications necessary? Mr. E. Robertson, in reply, states that "electricians wear the distinctive gilt buttons indicative of the rating of chief petty officer, and the same distinctive cap badge as engine-room artificers, but (like engine-room artificers) they wear no distinctive badges n dicative of special qualifications or duties on collar and cuff. The work of electricians is to carry out all necessary repairs to electrical apparatus. Candidates are not required to present indentures of apprenticeship to the trade, but three years' practical experience as fitter and turner is necessary. The qualifications required are:—Theoretical—Knowledge of general construction of electrical apparatus, motors, &c., and of simple testing. Practical—Re-lining and adjusting bearings; using lathe; screw-cutting test for bolt and nut; repairs to any part of electrical apparatus and instruments, motors, &c. There is also an educational test in reading, dictation, vulgar and decimal fractions, and simple interest."

Middlesbrough, Stockton-on-Tees and Thornaby Tramways.—On July 18th, the Bill promoted by the Imperial Tramway Co. for the construction of new tramways in Middlesbrough, was considered by the Chairman of Ways and Means Committee. Formal evidence in proof of the preamble having been given by Mr. Pritt, the measure was ordered to proceed. In the House of Commons on July 23rd the Bill was ordered for third reading.

Manchester Corporation Tramways.—This Bill came before the Chairman of Ways and Means Committee of the House of Commons (Mr. Emmott presiding) on July 18th. Mr. Pritchard explained that the Bill provided for the construction of about 3½ miles of tramways in Sale and Ashton at an estimated cost of £38,000 and street widenings in connection with the tramways at an expenditure of £12,000. Formal evidence having been given, the Bill was ordered to go forward. The Chairman of Ways and Means reports to the House of Commons that a period of 30 years had been assigned for the repayment of the loan of £38,000 required for the construction of tramways under the Manchester Corporation Bill.

Telegraph (Money) Bill.—In the House of Commons on 19th inst., this Bill was ordered for third reading.

Electric Supply Corporation.—This Bill came before Mr. Emmott's Committee of the House of Commons on Thursday, July 18th, and was ordered to proceed. The Bill authorises the transfer of electric lighting orders granted in respect to Exmouth, Hitchin, Sidmouth, Stevenage, Dawlish, Hendon, Teignmouth, Chelmsford, Totnes Dalkeith, Dollar, Jedburgh, and Melrose.

Third Readings.—In the Commons on 22nd inst. the Electric Supply Corporation Bill was read a third time, and the Oxford and District Tramways Bill was ordered for third reading. In the Lords the Richmond (Surrey) Electricity Supply Bill, the North Metropolitan Electric Power Supply Bill, and the Central London Railway Bill, were read a third time.

BUSINESS NOTES.

Dissolutions and Liquidations.—*Re* BRITISH ELECTRIC EQUIPMENT CO., LTD. — In regard to this liquidation (of which extended notice appeared in the ELECTRICAL REVIEW for May 24th), the managing director (H. G. Nicholson) has submitted a summary of statement of affairs as at the date of winding up, showing, as regards creditors, gross liabilities of £25,913, and an estimated deficiency of assets to meet liabilities of £10,343. On contributories' account there is a deficiency of £14,107, making a total deficiency of £24,450. This deficiency is explained by Nicholson. £9,611 is put down for expenditure in carrying on the business; £13,589 represents depreciation on goodwill, and there are other items of expenditure account, making altogether £26,111, from which there is deducted £1,661 "gross profit" on business, making the total deficiency as above. The assistant Official Receiver, in his observations, gives the following list of profits and losses on carrying out engineering contracts in connection with electric tramways for town and district Councils:—

Yarmouth contract	.. .. ..	a profit of	£601
Falkirk	"	"	1,780
Glasgow	"	"	181
Leyton	"	"	888
Barking	"	"	303
Ipswich	"	"	201
Bournemouth	"	"	416
Easington	"	"	204
Sunderland	"	"	971
Hetton	"	"	48
Gloucester	"	"	47
Canvey Island	"	"	1
Newport	"	"	1
Dover	"	a loss of	1,182
Walthamstow	"	"	1,185
Stockport	"	"	31
Darlington	"	"	206
Manchester	"	"	4
Brighton	"	"	2
Oxford	"	"	1

In regard to the charges given to Mrs. H. G. Nicholson from time to time, it is stated that after a careful investigation of the facts relating to the charges executed in favour of Mrs. Nicholson and the issue of the debentures, the Official Receiver came to the conclusion that some of the charges could be upset, and that the debentures in excess of £500 would be held to be invalid. After considerable negotiation an offer has been made on behalf of Mrs. Nicholson to obtain the withdrawal of certain claims, and to pay, in settlement of all matters in dispute between the company and H. G. Nicholson and herself, such a sum not exceeding £1,000 as will be sufficient to provide for the costs and a dividend of 2s. in the £ on the claims of the unsecured creditors. The matter has been fully considered by

the committee of inspection, who are of opinion that the offer should be accepted, and the necessary steps are being taken to carry out the arrangement. The fully-secured creditor (£6,148 12s.) is the company's banker, Coutts & Co., for loans amounting to £3,900 and the overdraft amounting to £2,248 12s.; their security consists of H. G. Nicholson's guarantee of the overdraft to the extent of £1,000, and Mrs. Nicholson's guarantee of the balance and of the loans. The partly secured creditor (£9,683 10s. 2d.) is Mrs. Nicholson, for the balance of the money advanced and the guarantees given; her security consists of the balances of the various debts charged, from which has been deducted an amount sufficient to enable the debentures to be paid in full. Mrs. Nicholson should have been charged with £688 15s., the amount paid to J. Cleland in respect of dividend on his preference shares, as shown in the deficiency account, which she guaranteed. The other liability (£275) represents the claim of a firm who supplied the company with goods, but against whom there is a large counter-claim for defective workmanship. As the result of the meetings of creditors and contributories, held on May 14th, the Official Receiver continues to act as liquidator, with a committee of inspection consisting of five creditors.

CAMPBELL AND ISHERWOOD.—Messrs. G. F. D. Campbell, S. T. Isherwood, and J. A. G. Williams, electrical engineers, Raleigh Street, Bootle, have dissolved partnership. Mr. S. T. Isherwood retires, and the remaining partners will continue the business and attend to debts.

JOSEPH RICHMOND & CO., LTD.—A petition presented by a shareholder for winding up this company is to be heard on July 30th in London.

WOLFRAM, LTD.—This company is winding up, with Mr. W. Barton, 8, Lawrence Pountney Hill, Cannon Street, E.C., as liquidator. Creditors must send in particulars of debts, &c, by August 17th.

The Price of Aluminium.—It is stated in interested circles in Germany that the sharp upward movement in the price of aluminium, which took place two years ago, and which brought the quotation up to from 3s. 3d. to 3s. 9d. per kilogramme, according to quantity and period of delivery, has been succeeded in the past six months by a decline of about 10 per cent. The price to-day has therefore to be assumed as ranging from 3s. to 3s. 6d. per kilogramme, according to time of delivery. Material for prompt delivery, which for some time commanded a large premium, seems again to be sufficiently kept in stock, so that the price difference between spot and future products has disappeared. If the reported reduction in price should be confirmed, it will merely substantiate the statements made at the recent meeting of the Aluminium Industry Co. of Neuhausen, or in the company's annual report for 1906, as to the prospects of a diminution taking place in the future, having regard to the gradual bringing into operation of new producing plants in several parts of the world, and the consequential augmentation in the output of the metal. The prediction of the Swiss company related to a reduction in price for 1908, when most of the new extraction plants will be at work; but it has apparently been fulfilled at an earlier period. American statistics show that the world's production of aluminium last year was as follows in metrical tons:—

	1906. Tons.	1905. Tons.	1904. Tons.	1903. Tons.
United States	6,000	4,500	3,900	3,400
Germany	3,500	3,000	3,000	2,500
France	4,000	3,000	1,700	1,600
England	1,000	1,000	700	700
Totals	14,500	11,500	9,300	8,200

The above figures are estimates, as producers of aluminium do not issue statistics relating to their respective outputs.

Trade Announcements.—E. BENNIS & CO., LTD.—Mr. E. Harris, 36, Richmond Mount, Headingley, Leeds, has joined this firm as their representative for East and South Yorkshire. Mr. Wm. Higson, Grindleton Villa, Levenshulme, Manchester, will still continue to be the firm's general representative for Lancashire and Yorkshire, as heretofore, but we are informed that of late years the business has grown to such an extent that it has been necessary to sub-divide the work and appoint a large number of representatives in the busy manufacturing centres of the North.

MESSRS. TAYLOR & CO., mica merchants and manufacturers, of 40, Hatton Garden, E.C., have taken into partnership Mr. John F. Podger, who has been connected with the mica industry throughout his business career. The firm recently removed to the above address, where they have large specially built and well-equipped premises.

We are informed that the ELECTRIC CABLE CO., of New York, has just bought the entire business of the Eastern Wire and Cable Co, of Roxbury, Mass., one of the oldest and largest manufacturers of rubber covered wires and cables in New England. Its entire equipment will be removed to Bridgeport, Conn., where it will be installed in the plant of the Electric Cable Co., which has in course of construction a large addition to its plant.

Mr. H. CLIFFORD PALMER announces that he has resigned his position as advertising manager to the General Electric Co., Ltd., in order to take an active part in the management of the Clifford Palmer Co., specialists in advertising, of 6 and 7, Creed Lane, Ludgate Hill, E.C. Mr. Palmer has made a close study of the publicity methods best calculated to produce beneficial results, particularly in connection with the electrical trade, and his company is prepared to devise advertising schemes, to compile catalogues and pamphlets free of charge, and to carry out printing orders for its clients on advantageous terms. Electricity supply undertakings are included within its scope. We wish success to the firm in its new venture.

THE GILBERT ARC LAMP CO., LTD., have appointed Mr. H. G. Barrett, of 209, Hope Street, Glasgow, to be their agent in Scotland for enclosed and open-type arc lamps, flame lamps, raising gear, transformers, &c.

MESSRS. FOSTER & CO., Wimbledon, makers of Foster's patent arc lamps, have appointed Mr. David Alexander, 43, Mains Street, Waterloo Street, Glasgow, to be their sole agent in Scotland.

Mr. W. ZOEBELL, of 130, Dickenson Road, Rusholme, Manchester, is sole agent for the Sächsiche Bronzewaarenfabrik Co., Ltd., of Würzen, Magdeburg, Berlin and Leipzig, makers of electric light fittings for theatres, hotels, mansions, &c., and also of electric reading and table lamps, &c.

ELECTRIC AND ORDNANCE ACCESSORIES CO., LTD.—This company's works and offices will be closed from the night of Friday, August 2nd, until the morning of Monday, August 12th.

ELECTROMOTORS, LTD., OPENSHAW.—The works and offices of this company are to be closed from Friday, August 2nd, to Monday, August 12th, for the annual holiday. A small staff will be in attendance to see to matters of urgency.

MESSRS. W. F. DENNIS & CO., of 49, Queen Victoria Street, E.C., have been appointed the sole agents in the United Kingdom for Heinrich Remy, G.m.b.H., Tiegelstahl-Werk, Hagen in Westphalia, Germany, makers of steel for magnets of all kinds.

Catalogues and Lists.—MESSRS. DICK, KERR & CO., LTD., Abchurch Yard, London, E.C.—New brochure (28 pp.), in which they give full descriptive particulars and a number of half-tone views and diagrams relating to their work in connection with the electrical equipment of cranes, hoists, &c. First-class printing and a good paper combine with careful arrangement to produce a handsome publication. The Dick, Kerr crane motors are described, as is also their metallic-shield blow-out controller.

MESSRS. HARDY & PADMORE, LTD.—From Mr. J. T. McArish, 32, Hornsey Rise Gardens, London, N., we have received a copy of this firm's catalogue containing new illustrations of pillars and other castings for lighting and tramway work; also a list giving approximate net prices, exclusive of lanterns or any internal fittings. Those who are in the trade can have copies of the list on application to the above address.

THE HAGEN ACCUMULATOR WORKS, 39, Snow Hill, E.C.—This company, which is the London depôt of the Cologne Accumulator Works, has issued new price lists of its accumulators. It is pushing the sale more particularly of small ignition plates, celluloid and ebonite boxes, and all rubber parts connected with accumulators, of which it is actual manufacturer from the raw material and on an extensive scale.

MESSRS. APPLEBYS, LTD., 56, Victoria Street, Westminster.—Copies of two new publications just issued; (1) Section C of their general catalogue describing and illustrating their hand-power jib cranes of all types and sizes, and giving prices of same; (2) showing and detailing their electric capstans.

MESSRS. HEAP & JOHNSON, 28, Hatton Garden, E.C.—Lists of "National" self-lubricating carbon brushes, copper gauze dynamo and motor brushes, dry cells, and Leclanché batteries. The firm has a large stock of carbon slabs suitable for cutting into brushes for emergency orders.

MESSRS. MICHAEL PAL & CO., Parliament Mansions, Victoria Street, S.W.—12-page booklet giving a description of their steam turbine propeller and centrifugal fans, also tabulated sizes, weights, prices, &c. Erection instructions, with diagrams, also appear.

MESSRS. D. SANTONI & CO. (1906), LTD., London, E.C.—Leaflet relating to opal, aluminium, and other reflectors, also glass shades for electric light fittings.

THE NEWALL ENGINEERING CO., LTD., Atherton's Quay, Warrington.—New catalogue (70 pages), in which are given the fullest particulars, accompanied with numerous finely executed illustrations, of their well-known Newall gauges. A number of new gauges not previously listed are now included, although the firm have in many cases been making them for some time. Among these are their standard screw gauges, pipe thread and hardened screw gauges illustrated on pages 36 to 39, and external micrometers which appear on pages 26 to 27. General articles appear describing the Newall system and equipments of limit gauges. At the end of the book there is a price list of all the gauges in the catalogue in metric sizes. No care or expense has been spared in the preparation of the catalogue, which we may justly describe as an artistic production, reflecting credit on all who have had a part in its production whether in the matter of arrangement, illustration, or printing.

MESSRS. R. J. NICHOLSON & CO., of Macdonald's Lane, Manchester, and 46, King William Street, E.C.—Revised edition of their brochure, "Light in the Country," in which their "Ideal" country house electric outfits are brought forward. They claim that there is a demand for an electrical equipment of this description at a price approximating to that of a self-contained gas-lighting plant. They have published a net price list for entire plants—engine, dynamo, storage battery and switchboard—for houses of various sizes, a copy of which they will send to anyone in the trade. The present pamphlet, "Light in the Country," is an 8 page antique paper production designed to interest the householder himself.

MESSRS. WARD & GOLDSTONE, Springfield Lane, Salford.—Latest supplementary price list of watertight and dust-proof electric light fittings for ship, mill, and colliery service, tramway work and exposed positions generally. Readers can obtain a copy of the list by dropping a card to the firm.

CONSETT IRON CO., LTD., Consett, Co. Durham.—Pocket booklet (40 to 50 pages) for the month of June, giving full particulars respecting their iron and steel manufactures, sections, plates, tests, and so forth. The company issues weekly sectional rolling programmes and periodical stock lists.

Bankruptcy Proceedings.—ERNEST BOHM, electric lamp manufacturer, 5, Boxworth Grove, Barnsbury.—Receiving order made July 16th, on creditor's petition. The first meeting is to be held on July 29th and the public examination on August 27th, both at Carey Street, W.C.

BLACKBURN, WALKER & Co., Upper Lane Mills, Cleckheaton, electrical and mechanical engineers.—August 3rd is the last day for receipt of proofs for intended dividend by W. Durrance, 29, Manor Row, Bradford.

G. A. BENTON, electrical engineer, Shareshill, Stafford.—August 3rd is the last day for sending proofs for intended dividend to S. W. Page, 30, Lichfield Street, Wolverhampton, the trustee.

Annual Outings.—On Saturday last, July 13th, the annual outing of MESSRS. MOUNTAIN & GIBSON, LTD., of Elton Fold Works, Bury, took place at Blackpool. Dinner, which was given by the directors, was partaken of at the Winter Gardens in the Victoria Hall, where 215 sat down. Mr. Wilks, general foreman, proposed a vote of thanks to the directors, which was seconded by Mr. Stead, chief draughtsman. Mr. Mountain, managing director and secretary, who replied on behalf of the directors, had a hearty reception; he said he was very pleased to meet so many of them, and hoped that by next year they would increase in numbers as they had done in the past year, as there was nearly double the number this time. Mr. Gibson was also well received, and in his remarks referred to the rapid progress of the firm. They wanted the men to feel that they were sharing in the prosperity of the firm. He was glad to say, as most of them knew, they had a lot of orders in hand, there were still more to come, and he hoped that there would be double the number of them at next year's dinner, as there was every prospect of it.

The first annual outing of the West Ham Corporation's electricity department took place last Saturday. A party of 104 went in four four-horsed brakes to Stanstead Abbots, in Hertfordshire. In addition to Mr. A. H. Seabrook, the engineer and manager, and men from all grades of the department, there were also present Mr. Alderman Littler, Chairman of the Electric Lighting and Tramways Committee, and Messrs. W. Davis, J. Halsey, J. Storey and W. J. Woodward, members of the West Ham Electrical Contractors' Association. On the way a brief stay was made at Woodford, where the company was photographed. At dinner short speeches were delivered by Mr. Alderman Littler, Mr. A. H. Seabrook and Mr. W. J. Woodward. Before separating outside the offices in Romford Road, three rousing cheers were given for Alderman Littler. Mr. W. H. Collings acted as secretary.

Staple-Driver.—Mr. T. SCHONER, of 3, Alexander Street, Park Lane, Leeds, is supplying a handy little staple-driver for fastening electric wires, wire netting and other like purposes. It is of steel entirely, and will take staples of several different sizes. A leaflet relating to the device will be sent on application.

Book Notices.—*An Exposition of the Prevention of Corruption Act*, 1906. By C. E. Brackenbury. London: Stevens and Sons. 1907. Price 1s. net.—This pamphlet is intended to make clear to the ordinary individual exactly what are the offences which are aimed at by the Act, and to assist him to distinguish between corrupt and innocent practices, by expounding the law before the passing of the Act, the defect for which the law did not provide, the remedy provided by Parliament, and lastly, the true meaning of the Act. It is shown that secret profits and commissions received by agents are nothing other than bribes, however they may be cloaked and quibbled about, and that the dishonest receipt of such cannot be justified by the plea of custom. The *Times* in 1877 suggested that "where paid professional agents, such as solicitors, engineers, and architects are concerned, it might perhaps be made criminal to take these fees in secret." That, says the author, has at last come to pass. Trade bribes are made crimes, on the part of both giver and receiver. The word "agent" includes "any person employed by or acting for another" or for any corporation, council or board of guardians, and the word "principal" includes an employer. Transactions in which a person gives an agent a receipt which does not show the discount received by the agent are covered by the Act. Amongst illustrative examples given by the author is a case of an architect acting for a Hospital Board, who is offered a special discount as an inducement to adopt a particular make of apparatus; the offer makes the manufacturer liable under the Act, and if the architect accepts it without disclosing the fact to the board, he also is liable. In an appendix the Act is given in full, and a second appendix exhibits part of it re-arranged so as more clearly to show its exact significance. The pamphlet should prove very useful to professional and business men.

Die Gleichstrommaschine. By Dr. E. Arnold. Vol. I. *Theorie und Untersuchung*. Second edition. Berlin: Julius Springer. Price 20 M.—This treatise on the theory of direct-current machinery is the standard German authority on the subject, and for detail and general comprehensiveness, it is far ahead of any English book. It is essentially a specialist's book, and is full of the study of what are at present minor points, although undoubtedly of interest, and of possible future importance. This method of treatment naturally makes it somewhat unsuitable as a student's text-book, because it fails to give any general view of the subject, or to impress the reader with the relative importance of the various points dealt with. As a reference book, however, it deserves full recognition, as it treats of many obscure points in connection with commutation, armature windings, iron losses, &c., in a masterly and simple manner. References to current literature are numerous, and the various recent experimental results are critically investigated and explained. The illustrations are excellent, and to a great extent new. The index, on the other hand, is incomplete, and should be much extended to satisfy the requirements of a reference book. At present it actually occupies less space than the table of symbols given at the end of the book. The multitude of these symbols is in itself a source of some trouble which might, perhaps, be mitigated by the more general use of formulæ in words. A second volume on the construction of direct-current machinery, and dealing with the applications of the theory of Vol. I, is to follow shortly.

Hilfsbuch für die Elektrotechnik. By Dr. Karl Strecker. Berlin: Julius Springer. Price 14 M.—This is the seventh edition of a useful compilation standing somewhere between the ordinary electrical pocket books and the text-books. The whole range of electrical practice is dealt with in a more or less detailed manner by the editor, Dr. Strecker, assisted by some twenty prominent German electrical engineers. The treatment is ampler than is usual in pocket books, but at the same time it is not an instruction book—the facts being usually stated with the minimum of explanation and without any attempt to meet the requirements of the beginner. Part I (96 pp.) contains the usual tables of physical constants, and deals with the general laws of physics, mechanics, electricity and magnetism. Part II (190 pp.) treats of electrical measurements and instruments, including meter calibration, machine testing, cell testing and photometry. Part III is divided into 18 chapters, and occupies the remainder of the book. It includes articles on the design and construction of electromagnets, transformers, direct and alternating current dynamos and motors, primary and secondary cells, as well as on the arrangement of central stations, mains and distributing systems for light and power, electricity on board ship, electric heating, electro-chemistry, telegraphy, telephony and various minor applications. An appendix contains particulars of the various German legal and other electrical regulations, and an unusually full index is provided.

"Bulletin of the Bureau of Standards." May, 1907. Washington: Government Printing Office.

"Physical Review," June, 1907. Vol. XXIV. No. 6. London: Macmillan & Co.

"Transactions of the Institution of Civil Engineers of Ireland." Vol. XXXII. Dublin: John Falconer. 1907.

"Fire Tests with Petrol Tanks." Report of the British Fire Prevention Committee. Red Books, No. 122. London: British Fire Prevention Committee, 1907. Price 2s. 6d.

"Transactions of the North-East Coast Institution of Engineers and Shipbuilders." Vol. XXIII. Parts 6 and 7. London and Newcastle: Andrew Reid & Co. 1907.

"Journal of the Institution of Electrical Engineers." Vol. 39, No. 184. London: E. and F. N. Spon, Ltd. Price 5s.

"Report of the Annual Meeting of the Industrial Freedom League held on July 4th, 1907." "Audit of the Accounts of Local Authorities." "Municipal Trading, Electric Light Undertakings: The Results of 12 months' Working." London: The Industrial Freedom League. 1907.

"American Street Railway Investments." Vol. XIV. New York: McGraw Publishing Co. 1907.

LIGHTING and POWER NOTES.

Beckenham.—The U.D.C. has received from the L.G.B. sanction to raise a loan of £5,460 for electricity purposes.

Bexley.—The local electricity station has been connected up with Foot's Cray, to which locality a supply is being given through the Foot's Cray Electric Supply Co.

Birkenhead.—The Electricity Committee of the T.C. recently decided that the charges for electrical energy for power and heating purposes, within the borough, should be:—For the first 1,500 units per quarter, 2d. per unit; for each additional unit from 1,500 to 5,000 units, 1½d. per unit; and for each additional unit in excess of 5,000 units, 1d. per unit. The decision gave rise to much discussion at a meeting of the Council.

Continental Notes.—ITALY.—A company has just been formed in Rome, with a capital of £20,000, and the title La Società Industriale Vomano, to put down plant to supply electrical energy for lighting and power purposes at Teramo.

GERMANY.—The municipal central electric lighting station at Charlottenburg is to be extended at an estimated cost of £66,200.

Derry.—The Port and Harbour Commissioners have decided to install electrical plant on their quays for hauling goods trucks.

Dundee.—The plans of the new generating station have been approved by the Electricity Committee of the T.C. The building will be a steel frame structure, and the plant will include two turbo-generators of 1,500 KW. The scheme also embraces the construction of two sub-stations—at Maryfield and Lochee. The total cost is estimated at £55,000.

Dungannon (Co. Tyrone).—The Dungannon electric lighting scheme, which has been hanging fire for a considerable time, has gone a step forward, an English firm having made an offer to the Urban Council. The present gas contract is about to expire.

Egham.—Notices of intention to apply for prov. orders for E.L. have been received by the U.D.C. from the Woking Electric Supply Co. and Messrs. Foote & Milne. The Egham Electric Supply Corporation has informed the Council that it is proceeding with the order, and only waiting for the formal approval of Parliament.

Faversham.—Messrs. Talbot & Stevenson, consulting engineers, writing to the T.C. with reference to the recent proposal to dispose of the electricity undertaking, say that it has occurred to them that energy is sold too cheaply to private consumers, particularly for power purposes, and that they think that the revenue might be increased and economies instituted, so that the business would meet all charges and justify the anticipations of its early supporters. The Council has decided that it is inadvisable to increase the charges for energy, but that endeavours shall be made as far as possible to reduce expenses.

Grimsby.—A L.G.B. inquiry was held on July 18th respecting the Corporation's application for a loan of £3,825 for electricity purposes. There was no opposition.

Guisborough.—At a meeting of the U.D.C. on Friday Mr. C. E. Lugard submitted a scheme for lighting the streets by electricity, and asked for permission to lay mains for private, as well as public, supply. For 30-C.P. lamps he said the cost would be 44s. per annum (1,400 hours' lighting) per lamp, and for 60-C.P. lamps, 58s. The Council referred the matter to a committee.

Henley-on-Thames.—The B. of T. has revoked the 1906 electric lighting order.

Herne Bay.—Messrs. Foote and Milne and Mr. M. Parker have notified the U.D.C. of their intention to apply to the B. of T. for prov. orders for E.L.

Ilkley.—The B. of T. has revoked the 1901 electric lighting order.

Kearsley and Little Lever.—The *London Gazette* for July 19th contains a notification of the proposed transfer of the prov. orders of the Kearsley and Little Lever U.D.C.'s to the Lancashire Electric Power Co.

Little Hulton and Tyldesley-with-Shakerley.—The U.D.Cs. give notice in the *London Gazette* of their intention to transfer their electric lighting orders to the Lancashire Electric Power Co.

London.—BATTERSEA.—The B.C. has come to an arrangement with Messrs. Mather & Platt in regard to their contract for condensing plant, by which a rebate in price and other concessions are granted; it is proposed to carry out certain mains extensions with a view to meeting the coming winter's load.

HAMMERSMITH.—The Electricity Committee has recommended, with a view to supplying the Franco-British Exhibition at Shepherd's Bush with electricity from May to October, 1908, that a bulk supply should be taken from the Kensington and Notting Hill Electric Lighting Companies. The maximum demand of the Exhibition will be 1,200 KW. of A.C. and 1,200 KW. of D.C. The exhibition authorities will guarantee a minimum payment of £10,000 for energy consumed, the rates being 2d. per unit, sunset to sunrise, and 1d. per unit at other times. The Council will guarantee the supplying company a minimum of one million units supply, which will cost them ·8d. per unit, or ·75d. if in excess of one million. It will be necessary for the Council to install transforming plant and to lay feeders up to the exhibition boundary.

STEPNEY.—A special meeting of the Council was to be held during the week, at the desire of the Electricity Committee, with a view to arriving at some definite decision as to the Blyth's Wharf scheme and its carrying out. The engineer has reported that mains extensions required would cost £27,000 if from the present station, as against £14,000 from Blyth's Wharf.

STOKE NEWINGTON.—The B.C. has received a cheque for £641 from the North Metropolitan Electric Power Co. on account of the deficit on the E.L. undertaking.

CITY.—The Streets Committee has made arrangements for the electric lighting of Holborn Viaduct, New Bridge Street and Cannon Street by the City of London Electric Lighting and Charing Cross Companies in competition, with a view to demonstrating the possibilities of modern electrical illuminating appliances.

Lowestoft.—A L.G.B. inquiry was held on July 15th into the application of the T.C. for a loan of £18,150 for E.L. purposes, viz.:—Services, £1,500; motors, £1,500; public lighting, £1,200; distributor, £3,500; feeder for Kirkley, £1,600; feeder to Nelson Street, £1,200; distributor for Kirkley, £1,700; feeder to Bridge, £1,500; oil filter, £250; motors for sale or hire, £3,000; free wiring, £1,000. With regard to the last item the Inspector (Mr. R. H. Bicknell) asked what security the Council had, and the Deputy Town Clerk (Mr. E. J. Cann) replied that every reasonable effort had been made to secure the Corporation. It was added that the object of the free wiring was to secure custom, and the charge for current would be 5½d. per unit, against 4½d. paid by ordinary consumers. There was no opposition.

Manchester.—The T.C. announces that from and after December 25th next, the price of energy for lighting will be reduced from 4½d. to 3⅔d. per unit on the flat rate, and to long-hour consumers from £7 per KW. of maximum demand and 1⅔d. per unit to to £7 and 1½d.

Maryport.—Messrs. Foote & Milne have informed the U.D.C. that they intend applying for a prov. order for E.L.

Nottingham.—An electric power plant has recently been installed by Messrs. E. Scott & Mountain for the Clifton Colliery Co., Ltd., Nottingham, which is interesting as affecting the comparative economy of compressed air and electricity in mining. The engines which have been used for driving the alternator were originally connected to compressors; when running at a speed of 55 R.P.M., the compressors required 578 I.H.P. The compressed air, at about 70 lb. per sq. in., was taken to the bottom of the pit, and there operated air engines for driving an endless rope haulage gear, dealing with 1,500 tons in 7½ hours, along a road 595 yards long with a gradient of 6 in. to the yard. A strap rope drove an in-bye haulage at the end of the gradient, and the whole of the power of the engines was absorbed in driving this machinery. The main engines were adapted for electric driving by fitting Proell governors and mounting on the crankshaft a Scott and Mountain three-phase generator of 300 KW. at 75 R.P.M. and 2,500 volts pressure. Current at the full voltage is taken direct to a motor of 125 H.P. for driving a Scott & Mountain endless rope haulage gear fitted with friction clutches, at the shaft bottom. At one of the shafts a distribution board is fitted, and energy is taken to another motor of 60 H.P. at the bottom of the incline. The conversion from compressed air to electric drive was made without stopping work at all, the change-over being made at week ends. The final result has been that, whilst the main engines originally developed 578 H.P., they are now doing rather more work and developing only 166 H.P. This example clearly demonstrates the very great advantage of electric driving over compressed air where electricity can be safely used underground, and it is interesting to know that, with the engines the Clifton Co. now possess, they will be able to do the whole of their pumping, electric coal cutting, additional haulage and shop driving, and lay off certainly two boilers, if not more. The suggestion to make this change-over and the general arrangement of the scheme was due to Major Walker, the general manager of the Clifton Colliery Co.

Oystermouth.—The U.D.C. has been informed that the Oystermouth Electric Supply Co. intends applying for a prov. order for E.L. for Mumbles.

Ravensthorpe.—The B. of T. has informed the U.D.C. that consideration of the revocation of the E.L. order will be deferred for a year.

Rawtenstall.—The T.C. has decided to ask the L.G.B. for power to borrow £29,000 to provide an electricity generating station at Hareholm and the equipment for a general electricity supply for the borough, including a supply for tramway purposes. Messrs. Lacey, Sillar & Leigh, electrical engineers, have been asked to prepare plans and estimates. It has also been decided to offer a certain price to the Rossendale Valley Tramways Co. for their undertaking, which it is proposed to electrify at the cost of the Rawtenstall Corporation. The Corporation is unwilling to combine with the Corporations of Bacup and Haslingden for the purchase of electricity in bulk from the Lancashire Power Co.

St. Annes.—The past year's working resulted in a gross profit of £4,534. The cost of production has been reduced from 1·39d. to 1·37d. per unit, while the average price has increased from 2·765d. per unit to 2·773d. Out of the profits a sum equal to 2½d. in the £ was devoted to the relief of the rates.

Sevenoaks.—The Mutual Electricity Supply Co., Ltd., has informed the U.D.C. that it intends applying for a prov. order for E.L.

Smethwick.—The T.C. has sealed an agreement for the transfer of the E.L. order to the Birmingham and Midland Tramways Co.

Tewkesbury.—Messrs. Foote & Milne have informed the T.C. that they intend applying for a prov. order for E.L.

The B. of T. has written to the T.C. asking what steps had been taken, or what it was proposed to do in the near future, to carry out the E.L. order, 1905. The Council has replied to the effect that if an extension of time is granted, it is probable that arrangements will be entered into for the transfer of the order to a company.

Walsall.—The B. of G. has decided to ascertain the cost of an E.L. installation for the workhouse. Last year gas cost £399, and it is estimated that by the use of electricity this would be reduced by over £200.

West Bromwich.—A L.G.B. inquiry was held on July 16th relative to the application of the T.C. for a loan of £4,925 for electricity purposes. It was stated that of this sum £4,600 had been spent, and that the balance was for the laying of mains. The inspector advised the amendment of the application to £6,150, £4,150 for expenditure up to March 31st last, and £2,000 for mains and services for the next two or three years, and this was done. There was no opposition.

West Ham.—The Electricity Committee has decided to order immediately a second turbo-generator, originally ordered for July, 1908, owing to the rapid increase in the load.

Willesden.—The E.L. Committee has decided to apply to the B. of T. for sanction to mains extensions in its district, costing some £6,000.

TRAMWAY and RAILWAY NOTES.

Aberdeen.—The receipts of the Corporation tramways for the year ending May last show a total revenue of £72,605, and working expenses amounting to £40,435; these items being an increase and decrease respectively, compared with the preceding year. After meeting financial charges a balance of £13,423 remains, comparing with £11,662 in 1905-6. Some 1,500,000 car-miles were run, the working expenses averaging 6·34d. The percentage of the working expenses to receipts was 55.

Aldershot-Farnborough.—The Light Railway Commissioners have informed Aldershot U.D.C. that they proposed to make an order authorising the construction by a private company of a light railway to be worked by electric traction from Aldershot to Farnborough.

Belfast.—Notice has just been issued to the motor-men and conductors of the Corporation that their engagements may expire on the 26th inst., as the electric power supply may fail on that date owing to the want of coals through the labour war in the city. The coal supply will last out till Friday, and by that time it is hoped that an amicable settlement will be arrived at. The notice affects about 500 men. Mr. Nance, the manager, whilst responsible for the above notice, is of the opinion that there will be no cessation in the tramway service. There is a large supply of gas coals on hand, so that the lighting of the city is not imperilled.

Continental Notes.—Marseilles.—It has been decided to build a tunnel 4½ miles long, to connect the city with the River Rhone by canal. The tunnel will admit of two barges passing; the barges will be hauled electrically, two tracks being provided, one on either side of the waterway. The tunnel will also be lighted by electricity.

Dundee.—It is stated that a firm of considerable standing have been making inquiries, and have even approached a leading citizen with a view to making an offer to the Corporation for the purchase of the tramway system. Notwithstanding that the capital value of the undertaking is £300,000, the parties are believed to be willing to pay an even larger sum, being convinced that there would be a splendid return on the money. It is stated that one reason that has led the parties to take up the matter is the success of the Dundee and Monifieth Tramway in the hands of a private company.

For some time past the Dundee tramway men have been complaining of a difficulty in connection with the B. of T. regulations as to speed. A climax has now been reachd, for, on behalf of the drivers it was stated to the T.C. that it was impossible to observe the regulations and the time-table, and in view of this it was agreed to ask the B. of T. to send down an inspector to investigate matters.

Haslingden.—The T.C. has instructed the local tramway company to proceed with necessary repairs to the permanent way, otherwise such repairs will be executed by the Council, and a charge made upon the company. In default the Corporation will reimburse itself out of the fund deposited by the company with the Council.

Liverpool.—The annual report of the Corporation tramways shows that during the year 1906, 122,094,528 passengers were carried, being an increase of 2,970,884. The traffic revenue was £563,777, and the aggregate revenue £571,216, exceeding that of 1905 by £14,160. There had been an increased expenditure of £9,903. The available balance was £82,756, of which one-third has been allocated to the rates, two-thirds being devoted to sinking fund and depreciation.

London.—L.C.C.—After a discussion extending over nearly two hours at Tuesday's meeting, the Highways Committee succeeded in securing a large majority in favour of the adoption of the G.B. surface contact system on the tramways between Aldgate and Bow. It might have been expected that having regard to the estimated saving by the introduction of this method instead of the conduit system, the hearty co-operation would have been obtained of those who now form the minority of the present Council, but this was far from being the case. The first recommendation made by the Highways Committee asked the Council to approve an expenditure of £72,210 in connection with the reconstruction of the Aldgate-Bow tramways on the G.B. system, and the whole of the debate centred around this proposal, and around an amendment, moved by Mr. Gordon and seconded by Mr. Goodrich, to refer the recommendation back to the Committee for reconsideration. Mr. W. Whitaker Thompson, chairman of the Highways Committee, defended the action of the Committee, and stated that it had been bombarded with other systems, but the Committee had selected that which, in its opinion, was likely to yield the most satisfactory results. On a division the amendment was rejected by 66 votes to 36, and the recommendation of the Committee was then carried. Various other recommendations, which were summarised in this journal last week, and which relate to agreements with the G.B. Surface Contact Co. for the use of the system, and with Dick, Kerr & Co. for the construction of the lines between Aldgate and Bow, were then adopted without further discussion.

The Proposed Traffic Board.—The adjourned report of the General Purposes Committee was discussed at considerable length at Tuesday's meeting of the L.C.C. The Committee recommended that it should be authorised to arrange for a deputation to wait upon the Prime Minister to urge the necessity of the Government securing the immediate establishment of a London Traffic Board upon the lines indicated in the report of the Royal Commission. As an amendment—Sir J. W. Benn moved that as it was undesirable that the development of tramways, street improvements, and buildings, which the L.C.C. controlled as the recognised authority representing the ratepayers, should be dealt with by a non-representative board of officials without financial responsibility, the recommendation should be referred back to the Committee for further consideration and report. The amendment having been seconded, a long discusssion took place. It was contended on behalf of the supporters of the amendment that the appointment of an advisory board would involve an expenditure of £30,000 per annum, and that the means of locomotion in London had so materially changed since the time of the constitution of the Royal Commission that the establishment of a traffic board was no longer necessary. These arguments, however, did not prevail with the majority, for on a division the amendment was defeated by 71 votes to 34, and the recommendation of the Committee was then agreed to.

Fulham.—A deputation representing the Franco-British Exhibition has urged the B.C. to expedite the construction of the proposed L.C.C. electric tramways from Putney to Harlesden. It was mentioned that the L.C.C. had statutory power to construct the trams on the conduit system, but had asked Fulham to consent to the overhead system. The latter had agreed conditionally, and it now only remained for the L.C.C. to push the work forward.

Northampton.—The returns of the borough tramways for the year ending in March, show total receipts amounting to £22,942; working expenses, at 5d. per car-mile (electric traction) and 9 38d. per car-mile (omnibuses), absorbed £12,532, leaving a balance of £10,410. After meeting financial charges, a balance of £2,355 remained, £1,000 being allocated to the rates and the balance added to reserve. The total car-miles run was 573,579, and the passengers carried, 5,400,000.

Rossendale.—Arbitration proceedings commenced on Thursday, at the Westminster Palace Hotel, London, between the Haslingden and Rawtenstall Corporations on the one hand and the Accrington Steam Tramway Co. on the other, as to the price each Corporation shall pay to acquire so much of the company's undertaking as is situate in their respective boroughs.

Salford.—New offices have been built by the Corporation in connection with the tramway system at a cost of £13,000. They consist of receiving offices, depôt, superintendent's office and residence, quarters for the overhead equipment staff, four wagon houses and stables, recreation and mess rooms for the men, and a parade room.

Wigan.—A large meeting of ratepayers has passed a resolution calling for a L.G.B. inquiry into the state of the Corporation Tramway undertaking, which showed a loss, last year, of £16,000.

York.—At a meeting of the City Council on the 18th inst., in committee, a report of the Tramways Committee was considered dealing with the provision of a system of electric tramways for the City. The Committee reported that it had had under consideration the following routes:—No. 1.—Railway Station to City boundary, Fulford. No. 2.—Railway Station to City boundary, Tadcaster Road, *via* Queen Street. No. 3.—Blossom Street to City boundary, *via* Holgate Road and Acomb Road. No. 4.—Lendal Bridge to Railway Bridge, *via* Gillicate and Haxby Road. The estimate for the cost was based upon these routes being adopted. It recommended that a double track should be laid on all the routes, which would comprise a total length of 5 miles 5 furlongs with the exception of about 250 yards, which must, of necessity, be laid with a single track. The cost of an overhead system was estimated to be £110,917, and of a surface contact system, £119,959. After a long sitting the Council resolved itself into a special meeting, and the adoption of the Tramways Committee's report was moved and seconded. The City Sheriff (Councillor Meyer) moved an amendment that the report be referred back to the Committee, with instructions to ascertain from the Light Railway Commissioners whether a clause can be inserted in an order for the construction of electric tramways in the City to the effect that the Corporation should not work the tramways themselves without taking a poll of the citizens, and that they should be authorised to take such a poll. This was seconded and adopted.

TELEGRAPH and TELEPHONE NOTES.

Austrian Telephone Installations.—It is reported by the Austrian newspapers that various telephone works, including the German firms of J. Berliner and the Siemens & Halske Co., have been given orders for the establishment of the first automatic telephone exchanges in Austria. The towns concerned are those of Graz, Krakau and Reichenberg, and the orders comprise 6,000 apparatus of the value of over £35,000. This sum does not include the cost of apparatus for the use of the subscribers to the exchanges.

Cocos-Batavia Cable.—The *Times of India* states that the landing of the shore end of this cable has been sanctioned, and that the cable will probably be complete within a year, giving an alternative route to Australia, the Far East and South Africa.

Police Telephones.—It is announced that at last Scotland Yard has been connected with the public telephone system, the number being 14,118, Central. The various police stations have for long been connected with Scotland Yard by private lines, but these have been used solely for official purposes.

Sahara Telegraphs.—Some interesting particulars of telegraph construction in the Sahara Desert are given in a Canadian paper, the *Victoria Times*. In order to avoid interference with camel caravans, the wires have to be supported at a height of 15 ft. from the ground, and are carried on hollow steel poles 18 ft. long. As the latter have to be transported on the backs of camels, they are made telescopic, so as to close up to a length of 5 ft., and are extended and locked when erected. The line already constructed extends through Algeria to Beni Abbes, a distance of 150 miles. Thence it will be carried to Adrar, 800 miles south of the Mediterranean in the heart of the desert, and finally to Burem on the Niger, a stretch of 860 miles. At the wells, 50 to 120 miles apart, small military posts, capable of defence by a dozen men, will be established. Repairs will be carried out by camel patrols, and will be facilitated (it is said) by the telescopic construction of the poles. The cost of the desert part of the line will be £80,000. Eventually connection will be established with Lake Chad, Timbuctu, and the existing line to Rammako and Senegambia.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Cayenne-Pinheiro	Aug. 18, 1902	July 11
Curacao-Coro Curacao-La Guayra Curacao-Maracaibo	Jan. 12, 1906	..
Reissa-Issa and Reissa-Yemani (Yemen)	Oct. 22, 1902	..
Tarifa-Tangier	Jan. 18, 1904	..
Port Arthur-Chifu (Closed)	Mar. 9, 1904	..
Garachico-Santa Cruz	July 12, 1906	..
Las Palmas-Arecife	Aug. 18, 1906	..
Brest-Dakar	July 22, 1907	..
Landlines.		
Puerto-Barrios	Aug. 2, 1902	..

Wireless Telegraphy.—According to an article in the *Daily Telegraph*, signals have been transmitted on the Poulsen system from Lyngby, near Copenhagen, to the west coast of Ireland, a distance of about 1,400 miles, with satisfactory results. Duplex telegraphy has also been found possible, and it is anticipated that several messages may be transmitted simultaneously in both directions. The Amalgamated Radio-Telegraphy Co. is making preparations to carry out experiments in wireless telephony on the Poulsen system, between Oxford and Cambridge, a distance of 60 miles.

It is stated that Mr. Marconi's recent experiments in trans-Atlantic telegraphy between Glace Bay and Poldhu have been successful, and, as usual, that speedy and uninterrupted wireless communication across the Atlantic will be completely solved.

CONTRACTORS' COLUMN.

OPENINGS FOR NEW BUSINESS.

ACCRINGTON.—Additional works for Howard & Bullough, textile machinists.

(HIGHER ANTLEY).—New Sunday schools (£2,500). Haywood and Harrison, architects, Post Office Chambers, Accrington; Geo. Cunliffe & Son, builders, Sydney Street, Accrington.

ABERCYNON (GLAMORGAN).—Two large shops and premises for the Pnysybwl Co-operative Society. A. L. Thomas, architect, Church Street Chambers, Pontypridd.

ALDERSHOT.—Wesleyan Soldiers' Home at South Camp. Robert Curwen, 149, Bishopsgate Street Without, London, E.C., architect.

Offices and works in High Street for W. J. May & Co.

AYLESBURY.—New church house. S. Mayne & Son, builders, Aylesbury.

BARNSLEY.—Cycle and motor works. W. T. Turner, architect, George Chambers, off Market Hill, Barnsley.

BIDEFORD.—Roman Catholic schools (£3,000).

BIRMINGHAM.—High school for girls in Clarendon Road (£12,000). H. T. Sandy, architect, Stafford.

BOLTON.—New coal mines to be opened by the Breightmet Colliery Co.

Extensions to Marsden & Co.'s Croft Lane Mills.

BRISTOL (FISHPONDS).—New hall adjoining All Saints' Mission Church in Grove Road.

BUCKINGHAMSHIRE.—New wing to Royal Buckinghamshire Hospital. F. Taylor, architect, 7, Bourbon Street, Aylesbury.

(POUNDON HILL).—New mansion for Mr. Heywood Lonsdale, M.F.H. Mr. Barnes, architect.

BURTON-ON-TRENT (TUTBURY).—New Council schools to be built.

CARDIFF.—New college in Cathays Park. E. Turner & Sons, builders, Penarth Road, Cardiff.

(CAERPHILLY).—Residence for Miss Morgan. D. M. Davies, architect, 24, Cardiff Road, Caerphilly.

(CREIGIAU).—Important additions to Henstaff Court. E. M. Bruce-Vaughan, architect, 21, Dumfries Place, Cardiff.

CHEQUERBENT (LANCS.).—Model dwellings. W. B. Johnson & Son, architects, King Street, Wigan; J. Fletcher, Dobbs Fold, Wallgate, Wigan.

CHERTSEY.—New Council schools to be built by the Surrey C.C.

CHESHUNT.—New public schools for Herts C.C. (£4,600). U. A. Smith, County surveyor, Hatfield.

CLITHEROE (LANCS.).—Extension to weaving shed at Chatburn, for the Chatburn Manufacturing Co.

COCKERMOUTH.—Extensions to the Fever Hospital, for the R. Wilson, 11, Main Street, Cockermouth. D.C. J. B.

CONGLETON (BIDDULPH).—New Council schools (£6,489). T. & E. Cooke, builders, Congleton.

(BIDDULPH MOOR).—New Council schools (£3,199). Jas. Heath and Sons, builders, Shoobridge Street, Leek.

CRIEFF (PERTHSHIRE).—Double cottage in Mitchell Street for Mr. W. H. Mungall, Croftweet.

CROYDON.—Market hall in Church Street. Courtney & Fairbairn, 977, Albany Road, Camberwell, S.E., builders.

CUMBERWORTH.—New Church of England School. J. Kirk & Sons, architects, John William Street, Huddersfield.

DARLINGTON.—Business premises for the T.C. Geo. Winten, borough surveyor, Town Hall, Darlington.

(SPRINGFIELD).—Extensive additions to engineering works. R. Stephenson & Co., Darlington, owners.

DERBY.—New Salvation Army Hall (£3,900). W. Ford & Sons, contractors, Derby.

DUNDEE.—Building scheme for National Telephone Co. (about £20,000).

Warehouses for David Thomson, Union Street, Maxwelltown.

DUNSTABLE.—New Council school. Gotch & Saunders, architects, Bank Chambers, Kettering.

EAST HAM.—Chemical factory for Burgoyne, Burbidges & Co., 12, Coleman Street, E.C.

EGREMONT.—Alterations to Central Stores. W. G. Scott & Co., architects, 2, Park Lane, Workington.

FOLKESTONE.—New Parish Hall for St. John's parish (£1,500). A. Bromley, architect, Radnor Chambers, Folkstone.

GRAVESEND.—New public school to accommodate 600 children to be built by the Town Council.

HARLESDEN.—New receiving home for children in Acton Lane (£3,000).

HASLINGDEN (LANCS.).—Extensions to Duckworth Clough Mill for A. Winsley and Sons.

HASTINGS.—Block of shops in Saxon Road. Philip Tree, architect, 59, London Road, St. Leonards.

HERNE BAY (KENT).—Extensions to Railway Men's Convalescent Home (£4,000).

HENDON.—Artisans' dwellings at Child's Hill for District Council. G. Hornblower, 2, Devonshire Terrace, Marylebone Road, W., architect.

HERTFORD.—Addition to Asylum for County Council (£23,000). G. T. Hine and Co., 35, Parliament Street, Westminster, S.W., architects.

HINDLEY (LANCS.).—Extensions to Hindley District Council's sewage works at Platt Bridge.

HUDDERSFIELD.—Municipal Secondary School. J. Henry Field, clerk to local education authority.

(HOLMFIRTH).—Conversion of Technical Institute into Secondary School. Smith & Ensor, architects, 1, Hartshead, Sheffield.

HULL.—Extensions to business premises for the Farmers' and Cleveland Dairy Co., Ltd. Edwin Bowman, architect, County Chambers, Newcastle-on-Tyne.

IPSWICH.—Alterations and additions to the Girls' Secondary School in Bolton Lane, for the Education Committee. E. T. Johns, architect, Tower Chambers, Tower Street, Ipswich.

KEMPTON PARK.—Workshops, &c., for Metropolitan Water Board (£8,500). W. B. Bryan, chief engineer, M.W.B., Savoy Court, Strand, W.C.

KENDAL (STOCK BECK).—New tannery works for W. & J. J. Little. Stephen Shaw, architect, 45, Highgate, Kendal.

LAIGHPARK (NEAR PAISLEY).—Extensions to works for T. White & Sons, engineers.

LIMERICK.—New theatre in lieu of old one which is to be demolished.

LIVERPOOL (GREAT MEOLS).—New Church (between £6,000 and £7,000). E. Kirby, architect, 5, Cook Street, Liverpool.

(FAZAKERLEY).—New Church (£3,000). Ward & Cogswell, architects; Isaac Dilworth, builder, 1, Childwall Road, Wavertree, Liverpool.

LLANELLY (TUMBLE).—Houses (18), shop and bungalow residence. Wm. Griffiths, architect, Llanelly.

LOUGHBOROUGH.—New Congregational Church in Frederick Street. Barrowcliff & Allcock, architects, Town Hall Chambers, Loughborough.

LOFTUS.—Extensions to offices for Skinningrove Iron Co., Ltd.

LONDON (ARGYLL STREET, W.).—Conversion of National Skating Palace into a circus. H. E. Sutton, 15, Hand Court, Holborn, engineer.

(FINSBURY PARK, N.).—Music hall for Moss's Empires, Ltd. F. Matcham & Co., 9, Warwick Court, High Holborn, W.C., architects.

(WESTMINSTER).—Wesleyan Methodist Hall. Lanchester and Richards, 47, Bedford Square, W.C., architects.

(BARKING).—Premises for London and Provincial Bank (£3,285). V. Vagnolin, 33, Stirling Road, Clapham Rise, S.W., architect.

(BLACKFRIARS).—Extensions, &c., to Maltina Bakery (£6,820). W. Egerton, 12, Queen's Road, Erith, architect.

(LEMON STREET, E.).—Warehouse for Wholesale Co-operative Society.

(GREAT PORTLAND STREET, W.).—Shops, showrooms, and offices. J. Simpson & Co., 48, Paddington Street, W., builders.

(GREAT PORTLAND STREET, W.).—Shops and offices. H. Holmes and Co., 6, Mortimer Street, W., agents.

(GREAT PORTLAND STREET, W.).—Extensions to premises over sites of 151-159, by Kate Newton, Ltd., milliners, 155, Great Portland Street.

(GREAT CASTLE STREET, W.).—Business premises. Hall Beddall and Co., Pitfield Wharf, Waterloo Bridge, S.E., builders.

(HACKNEY).—Buildings in Upper Clapton Road and Stamford Hill. H. C. Webster, 1, Gresham Buildings, Basinghall Street, E.C., surveyor.

(HACKNEY).—Workshops in Richmond Road. Rowlandson & Co., 267, Mare Street, N.E., builders.

(KILBURN).—Two shops in Kingsgate Road. J. W. Allen, Kingsgate Works, Kilburn.

(HAMMERSMITH).—Engine houses, &c., for Metropolitan Water Board (£27,200). Wm. B. Bryan, chief engineer, Metropolitan Water Board, Savoy Court, Strand, W.C.

(BISHOPSGATE, E.C.).—Married police quarters and ambulance station. Sydney Perks, City surveyor, Guildhall, E.C.

(BLACKHEATH).—Congregational school, hall and church (£5,500).

(SHEPHERD'S BUSH, W.).—Buildings on site of 5, Shepherd's Bush Green, and land at rear. F. B. Whinney, 8, Old Jewry, E.C., architect.

(KENSINGTON).—Chapel in connection with St. Charles's R.C. College. R. O'Brien North, 1, Clifford's Inn, E.C., architect.

(STRAND).—Restaurant in St. James's Street. E. Runtz and Ford, 10, 11 and 12, Walbrook, architects.

(STRAND).—Head mistress's house at St. Clement Dane's School. C. W. Reeves, 3, Gray's Inn Square, W.C., architect.

(SOUTHWARK.)—Warehouse in Roy Place. G. H. Elphick, Broad Street House, New Broad Street, E.C., surveyor.

(BRONDESBURY).—Seven houses. Done, Hunter & Co., High Road, Cricklewood, agents.

(WEST KILBURN).—Two warehouses for S. Barnett, 98, Salusbury Road, West Kilburn.

LONG EATON (DERBYSHIRE).—New secondary schools and pupil teachers' centre for the C.C. Mr. Woodis, county architect.

MANCHESTER.—New premises for the London, City and Midland Bank, Corporation Street. Plans in preparation.

New branch premises for the Union Bank of Manchester, at Brooklands. Plans in preparation.

MIDDLESBROUGH.—Alterations at the workhouse for the Board of Guardians. R. Lofthouse & Sons, architects, 129, Albert Road, Middlesbrough.

NEWPORT (MON.).—Alterations and additions to Zoar Presbyterian Church, Risca. W. Moses, architect, Glendale, Risca.

NORTHALLERTON.—New Grammar School to be built by the C.C.

PENTONVILLE (MON.).—Additional schools for County Council. W. Tanner, county surveyor, Newport, Mon.

PERTH.—Business premises and offices for W. E. I. Peddie, iron merchants (£7,000). Architect, J. W. Smart, York Place, Perth.

New villas for Mr. John Moncrieff, in Muirton Place.

New licensed premises with hall, for Mr. D. Reid, High Street, to cost £7,000.

POPLAR.—Hall in connection with Seamen's Mission, Augusta Street.

PORT GORDON (N.B.).—Additions to school for Enzie School Board. J. Jamieson, architect, 77, High Street, Elgin.

ROTHERHAM (MEXBOROUGH).—New secondary school (£15,800). J. E. Knight, architect, 33, College Street, Rotherham.

SHEFFIELD.—Extensive additions to Lodge Moor Hospital for the T.C. (£8,562).

SLOUGH.—New Council schools (£7,767). H. Flint, builder, High Wycombe.

SOUTHAMPTON (FREEMANTLE).—Wesleyan church, to be lit by electricity (£2,525). G. E. Smith, architect, 6, Braybrooke Terrace, Southsea; J. Nichol, builder, Bitterne Park, Southampton.

SOUTHEND-ON-SEA.—Block of shops and houses in Leigh Road. A. E. Day, Southend.

STALYBRIDGE.—New school for the Education Committee.

STOKE-ON-TRENT.—Two new schools to be built by Staffs C.C.

STOCKPORT (REDDISH).—New church for St. Agnes parish to be built.

SURBITON.—New infants' school in Alpha Road (accom. 200).

TAUNTON.—New swimming bath (£2,500).

TEWKESBURY.—Additions to Junior Council School for Education Committee. R. T. Phillips, surveyor, Shire Hall, Gloucester.

TRURO.—New chapel for the Training College (£1,200). E. Sedding, architect, Truro.

TWICKENHAM.—Alterations, &c., to Town Hall. F. W. Pearce, surveyor, Town Hall, Twickenham.

TYNEMOUTH.—Secondary school for Town Council. Builder, Mr. J. L. Miller, contractor, Prior's House, Prior's Terrace, Tynemouth.

UPPER POPPLETON (YORKS).—New Sunday-school premises for All Saints' Church.

WALTON (SURREY).—Houses, machinery, &c., for Metropolitan Water Board (£105,000). W. B. Bryan, chief engineer, Metropolitan Water Board, Savoy Court, Strand, W.C.

WAREHAM.—Twelve almshouses and hall (£3,646). Albert Marsh, builder, Wareham.

WATFORD.—Enlargement of library. W. H. Syme, 4, High Street, Watford, architect.

WEDNESBURY.—Extensions to Wesleyan Chapel at Springhead.

WEYBRIDGE.—Extension of Cottage Hospital and new Parish room (£2,000). Theophilus Allen, architect.

WHITBY.—Semi-detached villas. G. S. French, architect, Whitby; Kitchen and Sons, builders, Whitby.

WREXHAM.—New public schools (accom. 1,000 scholars). Lawson Taylor, clerk to Borough Education Committee, Guildhall, Wrexham.

WIGAN.—New Parish Church at Abram.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—January 8th, 1908. One common battery switchboard and 3,000 subscribers' telephones (specification No. 166) for the Deputy Postmaster-General, Adelaide. Specifications can be seen at the Commonwealth Office, 72, Victoria, Street, S.W.

Austria.—August 31st. The Austrian State Railway authorities at Czernowitz are inviting tenders for the establishment of an electric plant at the railway station in that town, for lighting and power purposes.

Barnes.—August 12th. Mechanical stokers, feeder and distributor cables for the U.D.C. See "Official Notices" to-day.

Birmingham.—July 26th. Electrical pumping machinery (800 H.P.) for the Birmingham, Tame, and Rea District Drainage Board. See "Official Notices" July 12th.

Bulgaria.—The State Finance authorities in Sofia have just invited tenders for the supply of 4,200 metres of telephone cable.

Calcutta.—January 2nd, 1908. According to the *Financial News*, tenders for any class of illuminant are invited by the Corporation for the lighting of the city.

Dublin.—Supply of motors on hire-purchase system for the Corporation E.L. Committee. See "Official Notices" to-day.

Edinburgh.—July 30th. Steam, exhaust and other piping for the Corporation electricity department. Frank A. Newington, electrical engineer.

Gothenburg.—The Commercial Intelligence Branch of the Board of Trade are notified by H.M. Consul at Gothenburg that tenders are invited for the supply of the electric equipment for the Government power station at Trollhattan, comprising three electric generators for direct current, each of 350 KW.; a battery of 4,800 ampere-hours capacity; four three-phase generators, each of a maximum of 11,000 K.V.A.; 12 transformers, each of a maximum of 3,670 K.V.A., connections, regulators and control tables. Sealed tenders, marked "Anbud a elektrisk utrustning for Statens kraftverk," should be sent to the Managing Director of the Royal Trollhattan Canal and Waterworks, Trollhattan, Sweden, by noon on October 1st next. Tenders are binding until January 1st, 1908. Delivery is to be completed by September 1st, 1909. Further information may be obtained from the managing director, from whom a copy of the programme can be had against a deposit of 50 kronor, which will be returned on receipt of a tender in accordance with the programme.

Gothenburg.—August 7th. Tenders are invited for the supply of 1,300 tons of iron masts for power transmission to Sydsvenska Kraftaktiebolaget, at Malmö. Delivery is to be effected between October 1st, 1907, and May 31st, 1908. Copies of programme and drawings may be inspected by British manufacturers at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, E.C.

Hertford.—Electric light installation at the Corn Exchange for the T.C. Borough Surveyor, the Wash, Hertford.

Kingston-on-Hull.—August 2nd. Pipe-work, ejector type condenser and pump for the electricity department. See "Official Notices" to-day.

Perth (W.A.).—August 6th. Desiccating apparatus with motor-driven air-pump for telephone cable work for the Deputy Postmaster-General. Specifications at the Commonwealth Office, 72, Victoria Street, S.W.

Portsmouth.—August 5th. Welsh steam coal for the tramways power station. See "Official Notices" July 19th.

Portsmouth.—August 14th. High-tension switchboard, and pipe-work for electricity supply extensions. See "Official Notices" to-day.

Spain.—August 12th. The Spanish Ministry of Public Works in Madrid is inviting tenders until August 12th for the concession for the construction and working of an electric tramway in the town of Valencia.

Spain.—The municipal authorities of Alcira (province of Valencia) have just invited tenders for the concession for the electric lighting of the town during a period of ten years.

Spain.—The municipal authorities of Mollex (Barcelona province) lately invited tenders for the concession for the electric lighting of the town, but not a single offer was received.

Sunderland.—August 22nd. Uniforms and caps for the tramway employés of the Corporation. See "Official Notices" July 19th.

Sydney (N.S.W.).—August 14th. The Deputy Postmaster-General is inviting tenders for telegraph, telephone and electric light material.

CLOSED.

Chester.—The Town Hall Extension Committee received tenders from six firms for electric light fittings for the portion of the new buildings now approaching completion. Each firm was informed that should their tender be accepted, and the fittings prove satisfactory, the fittings which will be required for the portion of the building not yet erected will be obtained from them, subject to the prices charged therefor not exceeding the prices in the tender accepted. The Committee has decided in favour of the acceptance of the designs accompanying the tender of Wright Bros. & Co., the prices being as follows:—

37 two-light adjustable pendants (for offices), not exceeding 25s. each.
33 one-light adjustable pendants (for hallkeeper's rooms and offices), 5s. 10d. each.
15 two-light pendants (for corridors), 6s. 4d. each.
13 one-light pendants (for lavatories), 3s. 8d. each.
One three-light electrolier (for Mayor's room), £2 7s. 6d.
One three-light pendant (for corridor), 6s. 9d.

Dublin.—The Lighting Committee has recommended the tender of Messrs. Ferranti, Ltd., for sub-station switchboards, at £2,068, and at £340 for the extra feeder panels at Fleet Street; the tender of the Electrical Transformer Co., Ltd., for the erection of 100-KW. transformers for sub-stations in Sackville Street and Pigeon House, and transformers in connection with the extension of the electric lighting to the Viceregal Lodge, at £2,320.

Ealing.—The Universal Electrical Manufacturing Co., of Peckham, have secured the order for 61 disconnecting feeder pillars for the borough. The capacity of the pillars ranges from 250 amperes to 1,000 amperes, and they are being made to the specification and instructions of Mr. J. Douglas Knight, borough electrical engineer.

Eastbourne.—The following tenders were submitted for extension of plant for the Corporation electricity works (Mr. J. K. Brydges, borough electrical engineer):—

Water-tube Boiler and Pipework.

Babcock & Wilcox, Ltd.	*£2,080
B. R. Rowland & Co.	1,996
J. Musgrave & Sons (Woodesons)	2,412
Clarke, Chapman & Co. (Woodesons)	2,152
Stirling Boiler Co.	2,054
Davies Patent Boiler, Ltd.	2,290

Extension to h.t. Switchboard.

Ferranti, Ltd.	£148 0 0
Cowans, Ltd.	122 10 0
" " (not erected)	*106 10 0

Spray Cooling Plant.

J. H. Harrison, Middlesbrough	*£257
Körting Bros., Ltd.	250

*Tender recommended for acceptance.

Hammersmith.—The B.C. received the following tenders for the supply of a motor-generator for use at the King's Theatre:—

Phœnix Dynamo Co. (provisionally accepted.—(*a*) amount, £182; (*b*) time of delivery, seven weeks.
Electric Construction Co.—(*a*) £140; (*b*) seven weeks.
T. Parker, Ltd.—(*a*) £168; (*b*) ten weeks.
British Thomson-Houston Co.—(*a*) £172; (*b*) eight weeks.
Crompton & Co.—(*a*) £176; (*b*) nine weeks.

The Council has provisionally accepted the tender of G. Hinchcliffe & Co. for the supply of Sgwborwen coal (to mix with 2,000 tons of Crynant recently contracted for), at 17s. 10d. per ton, for a period of six months. There were 14 tenders.

Johnson & Phillips's Contracts.—The following contracts have been placed with Messrs. Johnson & Phillips:—

For Cambuslang, for the County Council of Lanark.—Motor-generator, booster, switchboard and machine, also battery cables.
For Portland, for the Admiralty.—Cables, conduits, troughs, boxes, lamp pillars, &c., for H.M. Coaling Depôt.
For Ealing Borough.—Supply of cables.
For Hankow E.L. department.—Arc lamps.
For the Fleetwood Electric Light & Power Syndicate.—Cables.
For the L.C.C.—Complete high and low-tension switchgear equipment for eight tramway sub-stations, together with all cable for connecting machines.
For Handsworth U.D.C.—Tramway feeders and pilot cable, troughs, &c.
For Bermondsey B.C.—Supply of cables and boxes.

London.—The Highways Committee of the L.C.C. propose to extend the contract with the Western Electric Co. so as to include the supply at a cost not exceeding £9,000 of the low-tension cables required in connection with the reconstruction of the tramways from Aldgate to Bow. A similar extension is contemplated in regard to the supply of rails by Bolckow, Vaughan & Co., at a cost of £8,466 for the same tramways, and also in respect of the laying of cable ducts by Mr. J. A. Ewart; while the G.B. Surface Contact Co. is to supply and fix, for £3,360, surface contact equipments for 48 of the cars to be used on the Aldgate-Bow route. The following tenders have also been received by the Highways Committee:—

1.—Overhead Electrical Equipment.

Dick, Kerr & Co. (recommended)	£2,323
Brush Electrical Engineering Co.	2,389
R. W. Blackwell & Co.	2,413
British Insulated & Helsby Cables	2,852
Fry Brothers	2,851
S. G. Smith	2,962

The overhead electrical equipment is for the tramways from Beresford Square, Woolwich, to Wickham Lane, Plumstead. The Hadfield Steel Foundry Co. tendered for the special trackwork for these lines, at £967 5s., Edgar Allen & Co., at £1,064, and F. H. Lloyd & Co., at £1,295, the first being proposed for acceptance.

2.—Supply of 78 Feeder Pillars.

British Insulated & Helsby Cables (recommended)	£1,896
Thomas L. Scott & Co.	2,155
J. E. Spagnoletti & Co.	2,179
Dick, Kerr & Co.	2,245
Henley's Telegraph Works Co.	2,304
R. W. Blackwell & Co.	2,305
Callender's Cable Co.	2,356
Universal Electrical Manufacturing Co.	2,420
Tramway Supplies, Ltd.	2,424
Estler Brothers	2,445
Cox-Walkers, Ltd.	2,470
Brush Electrical Engineering Co.	2,521
Johnson & Phillips	2,535
Western Electric Co.	2,569
Wenham & Waters, Ltd.	2,678
Kelvin & James White, Ltd.	3,291
General Electric Co.	3,828

The following tenders have been received for the supply of one 5-ton and one 3-ton overhead travelling crane for the central car repair depot: Higginbottom & Mannock, six tenders ranging from £1,116 to £1,205; Ransomes & Rapier, two offers of from £1,200 to £1,370; J. Spencer & Co., £1,240; Appleby's, Limited, £1,276; and T. Broadbent & Sons, £1,305. The tender of the first firm is to be accepted for the sum of £1,205, which provides for motors of the type furnished by the Electric Construction Co.

The tender of Willans & Robinson for two turbo-generators has now been amended, so as to provide for its acceptance at £43,195, including the provision of spare parts. The list of tenders was published a week ago.

Pembroke.—The U.D.C. has accepted the tender of the Union Electric Co., Ltd., for the supply of flame and arc lamps, at £133, and that of the Switchgear Co., Ltd., at £347, for switchboard, &c.

FORTHCOMING EVENTS.

Friday, July 26th.—At 3 p.m. Civil and Mechanical Engineers' Society. Visit to the motor-car works of the Simms Manufacturing Co., Ltd., Willesden Lane, Kilburn, N.W.

Tuesday and Wednesday, July 30th and 31st.—Aberdeen meeting of the Institution of Mechanical Engineers.

Wednesday, July 31st to August 7th.—Annual meeting of the British Association for the Advancement of Science, at Leicester. Wednesday evening: Presidential address by Sir David Gill, K.C.B., F.R.S., &c. Thursday morning: Sectional addresses; Section A, Prof. A. E. H. Love, F.R.S., chairman; Section G (engineering), Prof. S. P. Thompson, F.R.S., chairman.

NOTES.

City and Guilds of London Institute.—The report of the Council for the year 1906 mentions the negotiations which have been in progress between the Board of Education and a special committee of the Institute, with a view to formulating a scheme for the organisation of a new Technological Institution at South Kensington, with which the Institute and its colleges should be associated. The draft scheme has been approved by the Executive Committee.

The number of students passing through the Electrical Engineering course at the Central Technical College, which had exceeded the number following the Civil and Mechanical Engineering course from 1902 to 1905, fell short of the latter in the year under consideration, the respective numbers being 135 and 192, as compared with 160 and 145 in the previous year. A further increase in the staff has been made, but difficulty is met with in finding room for new apparatus and accommodation for the students. The Siemens Memorial Medal and Premium in Electrical Engineering was awarded to E. A. F. Goodfellow. The average age of candidates for matriculation is improving, and in spite of an increase in the fees from £30 to £36, the number of candidates is nearly the same as in previous years. There are over 450 students at the College.

The new building of the Technical College, Finsbury, is practically complete, and the whole of the work of the College is now conducted under one roof; but much of the new machinery and apparatus is not yet in place. The extension has been made possible mainly by an anonymous gift of £10,000. At the close of the session 224 students were attending the day classes, of whom 97 were in the Electrical Engineering Department; and there were 328 evening students.

With regard to the Department of Technology, a new syllabus of examination in Electrical Wiring has been prepared, on account of the large number of failures in this subject, and in future certificates will be awarded in two grades.

The total income of the Institute for the year was £44,848, and the expenditure £48,456. The amount received as fees from students at the Central Technical College was £12,935, and the net expenditure £18,604; fees at the Technical College, Finsbury, were £3,374, and the net expenditure £10,508.

At a meeting of the Council of the Institute, held on Monday, the Council awarded the diploma of "Associate of the City and Guilds Institute" to the following matriculated third-year students of the Central Technical College who have completed a full course of instruction as prescribed by the Council in Electrical Engineering:—J. W. Wheeler (Siemens Medal and Premium), C. H. Harvey, A. Collins, P. E. Hosegood, A. Kinnes, C. H. Toms, C. G. Barker, R. P. Abel, H. R. Rivers-Moore, H. E. Parry, L. N. Vine, J. O. Fraser, J. M. McG. Whellens, L. G. Dalais, C. A. Schurr, L. B. Sparks, G. E. W. Broade, E. H. Child, W. R. Harding, B. A. Tubini, C. H. Lauth, J. B. G. Northcott, C. Latham, L. T. Young, H. L. Bazalgette, J. McL. Donald.

Electric Supply Football League.—We are asked to announce that a committee meeting will be held at the offices of the St. James Supply Co., Carnaby Street, W., on Tuesday, July 30th, at 6.45 p.m.

Puerility and Redundancy ad Nauseam.—A regular contributor to our pages, to whom we sent for comment a number of magazine articles, has sent us this article. For the sentiments expressed we assume no responsibility:—

"Two quotations from a very wise king, complaining, even in his day, of lack of novelty and redundant literary effort, at once occur to the conscientious purchaser of certain monthly magazines dealing with engineering topics. The present writer, with several articles from magazines printed upon highly glazed paper before him, is inclined to inquire for what purpose certain pages have been filled with compilations of catalogue photographs, or with disquisitions upon exceedingly elementary subjects?

"One such article on the steam turbine, adorned in its opening sentence by the trade mark of a well-known firm of water-tube boiler makers, describes undershot and overshot water-wheels, and, passing on to steam engines, devotes an area of about 12 in. to a diagram of a reciprocating engine fit for a kindergarten. That the compiler did not drag in Hero of Alexandria marks great self-repression. It might reasonably be imagined that every engineer, down to the youngest student, had at least two books on steam turbines, and that there was no need for a recitation of the most elementary facts concerning the essential difference between Parsons and Curtis turbines.

"But matters are even worse in one of several articles on boiler economy, illustrated with half-tone blocks, reeking of the up-to-date catalogues of various makers. One gem in this article is really worth noting. Speaking of marine practice, we have the sapient observation that 'water from jet condensers is almost as salt as brine.' What constitutes brine depends upon the industry in which salt solutions are under treatment. But taking average

sea-water as containing 3·4 per cent. of total chlorides and allowing 19 lb. of condensing water per lb. of steam condensed, the value of the total chlorides present would be 3·23 per cent. Who then would dream of using jet condensers with sea-water, or, indeed, any 'bad' water as the cooling medium? Apart from this point, the article is merely a set of boiled-down descriptive matter and photographs.

"Another writer in another magazine, in a dissertation upon efficiency in fuel burning, remarking upon American conditions, observes that 'we have enormous power plants, in which even a small percentage of loss may represent a cost equalling the income of a millionaire.' This is a very pretty declamation, but it would only be convincing if the fuel bill of a large installation had been put forward, and if the comparative income and the 'small percentage' had been defined. The writer of that article then deals at length with the necessity for keeping down the excess of air supplied to the furnaces, and recording the percentage of carbon dioxide in flue gases. Not a word is said concerning local circumstances, which may profoundly modify the ideals which the engineer would seek. Such a case is that of the by-laws respecting the emission of smoke, which render it necessary to disregard economy where bituminous coals are used. There is nothing novel in preaching attention to this subject, and every engineer caring about thermo-dynamics would look askance at any boiler tests which do not contain this information.

"Why, therefore, all this redundancy? There are some things which an engineer should learn in his college days, and in regard to which he should supplement his knowledge by experience, observation and reading. But who is presumed to be a reader of all this accumulation of (mostly vain) repetition! Truly it is a weariness to the flesh."

The Copper Situation.—Messrs. Henry R. Merton's mid-monthly copper circular records a price of £94 10s. per ton for standard copper for July 15th last, with visible supplies aggregating 12,700 tons, an increase of 402 tons during the fortnight. A decrease in stocks at Liverpool and Swansea has been counterbalanced by an increase in the quantities afloat from Chile and Australia. The bear sentiments, which were so strongly in evidence early last week, when copper for three months' delivery sold at £85 10s., became modified when it was realised that the Amalgamated Copper Co. was securing 22 cents per pound from American purchasers. The price for three months' delivery therefore hardened to £88 10s. The margin between present realisations and future anticipations being in the neighbourhood of £6 per ton, indicates a widely held assumption that the back of the boom is weakening. But before prices in the neighbourhood of £80 for immediate delivery arrive, there will be several periods of irregularity, of alarm, and of bear squeezings.

Institution and Lecture Notes.—PHYSICAL SOCIETY.—At the meeting held June 28th, 1907, Prof. W. E. Ayrton, Past-President, in the chair, Mr. J. T. Irwin gave a demonstration of the uses of his hot-wire oscillographs and hot-wire wattmeters. After giving an explanation of the principle of the hot-wire oscillograph, and pointing out how to obtain exact compensation for the heat capacity of the wires by means of electric capacity or self-induction, he showed a number of experiments. Mr. Irwin also showed a new type of synchronous motor which he has invented and which can be run easily at synchronous or half-synchronous speed. This motor consists essentially of a series motor with laminated fields and with two points on the commutator, 180 electrical degrees apart, shorted. A hot-wire instrument to measure mean watts was also shown.

Mr. J. S. Dow described a form of photometer in which the cosine law was utilised; it was therefore unnecessary to move either the photometer or the sources of light. The adjustment of the illumination of the photometrical surfaces was carried out in the photometer itself by the rotation of a Ritchie wedge about the boundary-line between the photometrical surfaces as axis. The ratio of the candle-powers of the two sources of light compared could then be read off on a suitably calibrated scale attached to the photometer. This instrument could be used on the equality of brightness principle, or, by utilising an oscillating lens, as a flicker photometer. An experiment was shown illustrating the behaviour of the "rods" and "cones" as regards flicker. At strong illuminations, when the cones were predominant, the perception of form and colour was most acute when the central portion of the retina was utilised; but at low illuminations, when the rods were in action, visual acuteness was best when the outer region of the retina was used. In the same way the perception of flicker was demonstrated to be only most acute over the portion of the retina removed from the centre of the eye when a weak illumination was employed. A distinction must be drawn between "rod-flicker" and "cone-flicker." Some experiments were then shown illustrating the detail-revealing powers of red and green light. A green or blue surface loses in luminosity as the image of it falls more and more towards the centre of the retina. But apart from the question of luminosity, the red end of the spectrum gives the best definition in the case of distant vision and the blue end in the case of very close vision. The red end of the spectrum is therefore, in general, the most effectual portion for the illumination of clocks, shop-signs, and objects which must be viewed from a distance.

A paper entitled "Experiments on the Production of Sand Ripples on the Sea Shore" was read by Mrs. Ayrton. The sand-ripples which form so marked a feature of the shore, although parallel to the line of the breakers, are not produced by their edges, but are formed entirely under water. To show this, a glass trough, 6 ft. long, in which there was level sand covered with a foot of water, was pushed to and fro on rollers by means of an electro-motor. This motion set the water oscillating, and soon small ridges were seen in the sand, at nearly equal distances from one another, growing larger and larger as the oscillation continued.

JUNIOR INSTITUTION OF ENGINEERS.—We are informed that M. Gustave Canet has been elected President of this ever-advancing Institution for the ensuing session, in succession to Mr. William B. Bryan, chief engineer to the Metropolitan Water Board, and that he will deliver his Presidential address on Monday, November 18th next, taking for his subject "The Latest Improvements in English and French Modern Artillery."

LIVERPOOL AND DISTRICT ELECTRICAL ASSOCIATION.—The first meeting of the above Association was held at the Common Hall, Hackins Hey, Liverpool, on 16th inst. In the unavoidable absence of Mr. J. E. Lloyd Barnes, the chair was occupied by Mr. J. J. Richardson, of Liscard. The scheme, and position up to date, was explained by Mr. S. Frith, the promoter and hon. secretary, and supplemented by remarks by the chairman; afterwards considerable discussion took place. It was decided that the present Committee, formed by Mr. Frith, should continue to carry on the business for a term of three months, when the question would come up for further consideration. On Saturday, July 27th, the Association will pay a visit to Formby power station, by permission of Mr. H. E. O'Brien (Lancashire & Yorkshire Railway). The party will leave Exchange Station by the 3.10 p.m. train. The next meeting will be held in the Common Hall, Hackins Hey, Dale Street, Liverpool, at 8 p.m., July 30th.

Curtis Turbine Tests.—The Commonwealth Electric Co., of Chicago, U.S.A., has installed during the past year in their Fisk Street station four 9,000-KW. Curtis turbines. In order to obtain reliable information in reference to the economy of these sets, independent engineers were employed to make a series of tests on one of them. These tests were carried out with the greatest care, and the results were repeatedly verified before being accepted as final. The table given below contains the results of these tests, and shows an economy which is believed to be better than that obtained in any previous tests within the same ranges of temperature and pressure, the flatness of the water rate curve over such a large range of load being very remarkable.

Load in kilowatts.	Gauge pressure, lb.	Vacuum, inches.	Superheat, degrees F.	Water-rate, lb. per KW.-hour.
5,374	182	29·43	133	13·15
8,070	197	29·55	116	13·0
10,186	176	29 47	147	12·9
12,108	182	29 34	148	13·05
13,900	198	29·31	140	13·6

Results practically similar to those obtained at Chicago have also been obtained on a 5,000-KW. unit of similar design, installed in the station of the Boston Edison Co., and tested on January 29th, 1907, the figures being as follows:—

Load, 5,195 KW.; gauge pressure, 174 lb.; vacuum, 29·3 in.; superheat 142° F.; water-rate, 13 52 lb. per KW.-hour.

This difference from the Chicago figures is fully accounted for in the losses of the generator alone. When reduced to similar conditions these figures differ by only 0·3 lb. from those obtained at Chicago. The Boston tests were verified by three separate runs with different sets of instruments, some of which were specially calibrated for the purpose. These figures appear to demonstrate that the large clearances which are characteristic of the Curtis turbine have no detrimental effect upon its economy.

Italian Electrical Congress.—The Associazione Ellectrotechnica of Italy will hold their annual meeting at Parma next September. From the 23rd to 26th will be devoted to the reading of papers. Excursions to the Carrara marble quarries and to the petrol mines at Villeir will be made. At the same time, the (Italian) Association of the Electrical Press will hold their meeting.

Appointments Vacant.—Electrical engineer for Old Bleach Linen Co., Randalstown, Ireland (35s.); Assistant clerk for the Shanghai Municipal Council (£28 per month).

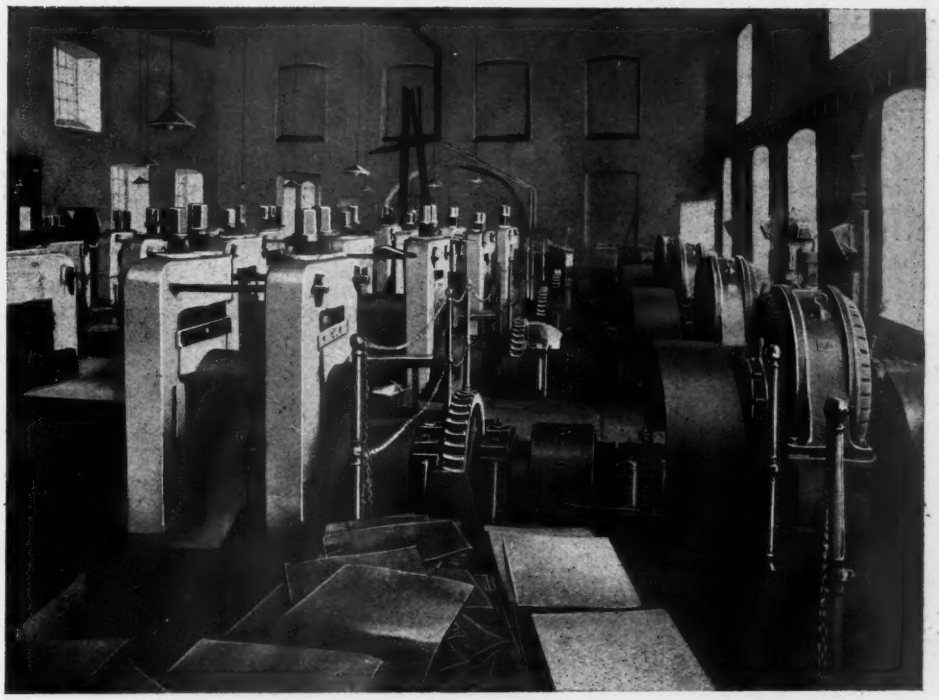
New Platinum Discovery in Russia.—According to a Russian correspondent, fresh discoveries of platinum have recently been made in the region of the Ural, which is practically the sole district yielding this precious metal. The finds have been located about six miles distant from the Barantchinsky works, along the river Schoumikha, which is a tributary of the Barantchi river. The platiniferous sands, which are found at very slight depths, have attracted the special attention of the inhabitants of the adjoining district, who, by stealing the sand, have been earning several hundreds of roubles every month, notwithstanding the employment of the most rudimentary method of washing it. It has been necessary to requisition the services of the military, who, by the use of arms, have put an end to this system of illegal working. The existence of platinum in this particular latitude had not been recognised until the recent discoveries, although gold is worked in that quarter. The platinum is of a dark shade, and apparently also contains iridium, and samples of the sand have been asked for in the United States for analysis by the Geological Survey. The exports of platinum from Russia in January and February of this year amounted to 22 poods, as compared with 46 poods in the equivalent period of 1906, being a reduction of 24 poods. The production in the first four months of 1907 is stated to have reached 7 poods 7 lb. (1 pood = 36 lb.) on the lands of Count Schouvaloff, as contrasted with 6 poods 33 lb. in the corresponding period of 1906, and to 7 poods 9 lb. on the domains of Prince Demidoff, as against 8 poods 3 lb. in the same terms respectively.

ELECTRICAL DRIVING IN SOUTH WALES.

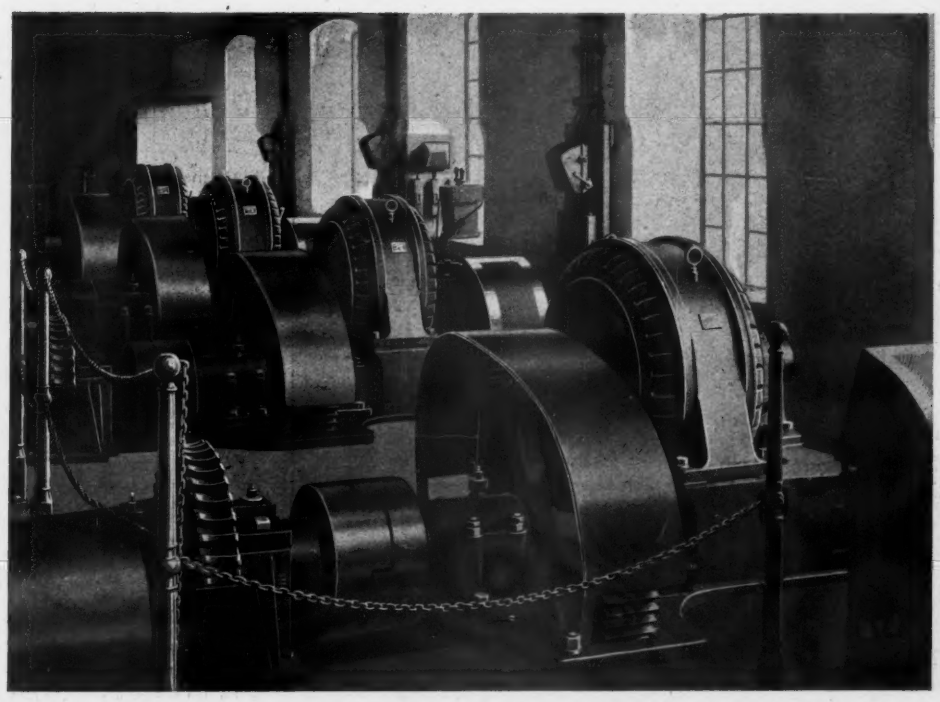
AN ELECTRICALLY-DRIVEN TINPLATE ROLLING WORKS.

Through the courtesy of Messrs. Bruce Peebles & Co., we are enabled to describe what was probably the first example of electrical driving of tinplate rolls in South Wales, and which has been in successful service for some time.

In this case the rolls are of the non-reversing type, and operate continuously for fairly long periods, thereby simplifying matters. It was necessary, however, to meet the heavy load fluctuations due to the entering and rolling of the plates, also to provide close speed regulation, including slow-speed operation for turning up the rolls. The latter are arranged in four trains, each of which consists of three pairs of rolls. A 50-H.P. Peebles slow-speed slip-ring induction motor is geared to each roll shaft. The speed is approximately 240 R.P.M. at full load, and the motors are rated on a temperature rise of 70° F. for continuous running; the overload allowance is over 100 per cent. for short periods. Rheostatic starter-controllers of the liquid type are used,



General View of the Electrically-Driven Tinplate Rolling Plant.



View showing the 50-H.P. Bruce Peebles Induction Motors Coupled to the Main Rolls.

allowing of fine graduation in speed, but generally these are short circuited in normal running.

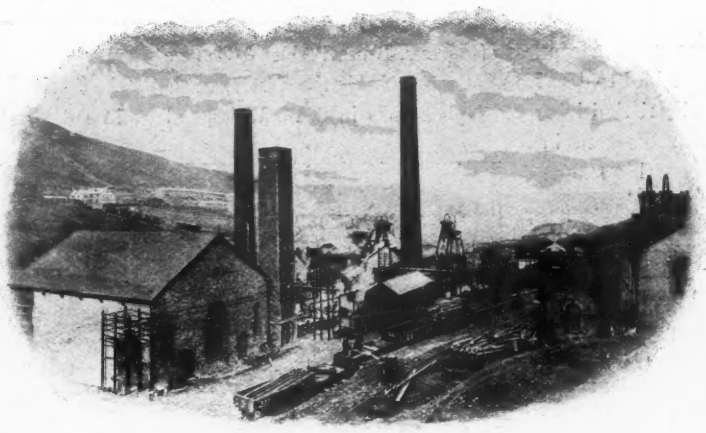
With a view to avoiding heavy starting currents such as would result from starting the rolls with the main motors, a 10-H.P. Peebles slip-ring motor, running at 750 R.P.M., has been installed for starting all four trains of rolls; this drives an underground worm shaft running the full length of the room at right angles to the roll shafts. The worm for each train of rolls is fitted with clutch mechanism, so that it can be thrown into gear with the rolls when required. It starts and drives them up to the maximum speed of the worm-shaft

motor, which is reduced to 2 R.P.M. at the rolls. The worm is then declutched, and the main roll motor takes up the running and accelerates the rolls up to the required speed.

As Messrs. Bruce Peebles had no precise data upon which to base their estimates, the fact that their calculations as to the probable power required, have proved to be within 5 per cent. of the exact requirements, as since measured, is a gratifying result. This power for the twelve sets of rolls is 150 B.H.P. in full service, or 12·5 B H.P. per pair of rolls, which is regarded as very low. The output of the mill has, moreover, been increased from a little over 3,000 to fully 4,000 boxes per week, a result which is attributable mainly to the absolute steadiness of the drive, and which also has the effect of turning out cleaner and better work all round.

The rolls are 18 in. dia., and vary from 24 in. to 46 in. in length, according to the size of tinplate.

The power plant consists of a 200-KW. Peebles-Belliss steam alternator, operating at 550 volts and 50 cycles, and generating three-phase current.



View of the Cambrian Collieries and New Engine House.

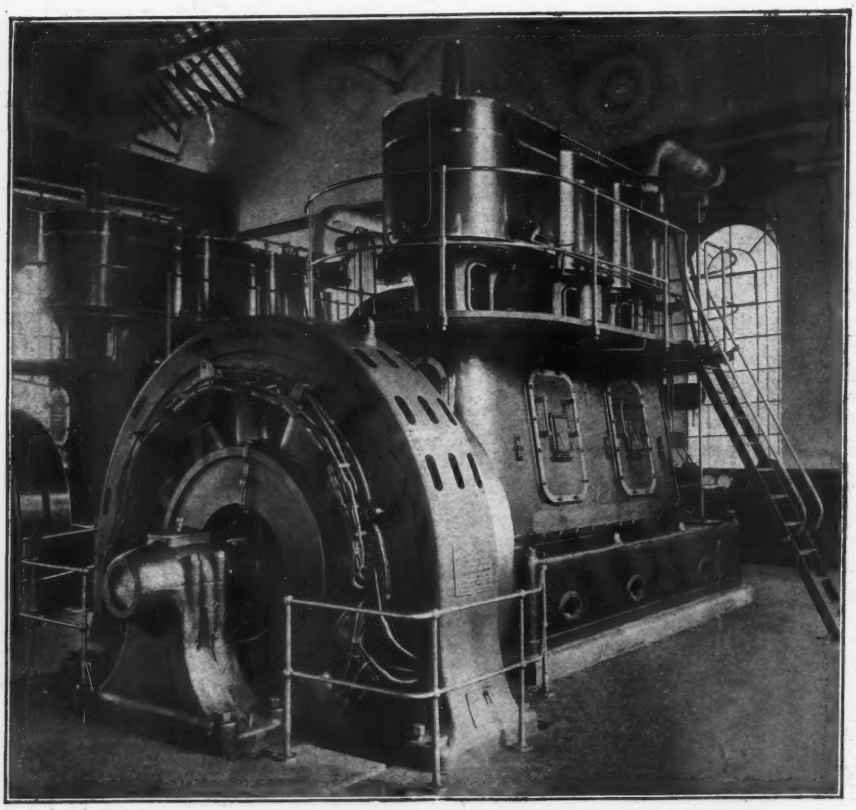
A SOUTH WALES COLLIERY INSTALLATION.

The Cambrian Collieries, situated in Clydach Vale, a branch of the better-known Rhondda Valley, Glamorgan, is one of the largest in South Wales; the coal produced in the three pits of the company averages about 1,000,000 tons per annum, and employment is found for some 3,500 men.

Up to a few years ago, steam power was exclusively used for operating the machinery both above and below ground, and this agency is still used for a number of purposes above ground. About three years ago it was decided to introduce electricity for working haulages, coal-cutting machinery, pumps, &c., the supply being purchased from the South Wales Power Co., and distributed to various motors in the mine and on the surface.

As this proved satisfactory, the management, advised by their consulting engineer, Mr. C. P. Sparks, decided to go a step further and generate their own electricity; an up-to-date power plant was, therefore, installed, the contractors being Siemens Bros.' Dynamo Works, Ltd., who sublet the engines, boilers, condensers, and so on.

The electric plant at present installed is principally used for operating induction motors, of which some 21 are in use, ranging in size from 220 to 3 H.P., the total H.P. of motors, being 1,890. Motors on the surface are supplied with three-phase current at low pressure, the current being transformed for this purpose by static step-down transformers from 2,200 volts (the generated pressure) to 400 volts. The bulk of the supply, however, is conveyed in cables at a pressure of from 2,000 to 2,200 volts down the pits, and distributed to the various motors at that pressure. Continuous current for exciting the main alternator fields, local lighting, and for working the original motors, is supplied at a pressure of 110 volts by a 36-KW. steam-driven dynamo, or alternatively by two 70-KW. motor-generators taken over from the original plant.



Siemens-Belliss 1,000 K.V.A. Three-phase Generator, Cambrian Collieries.

Only part of the electrical energy available is utilised at present, but as electric motors are being constantly added, the power house will be fully loaded at no distant date. Space has been left in the engine house for the erection of additional plant when this becomes necessary, and provision has been made in the design of the switchboard, boiler and condenser plant, &c., for carrying out this extension with a minimum amount of expense or alteration.

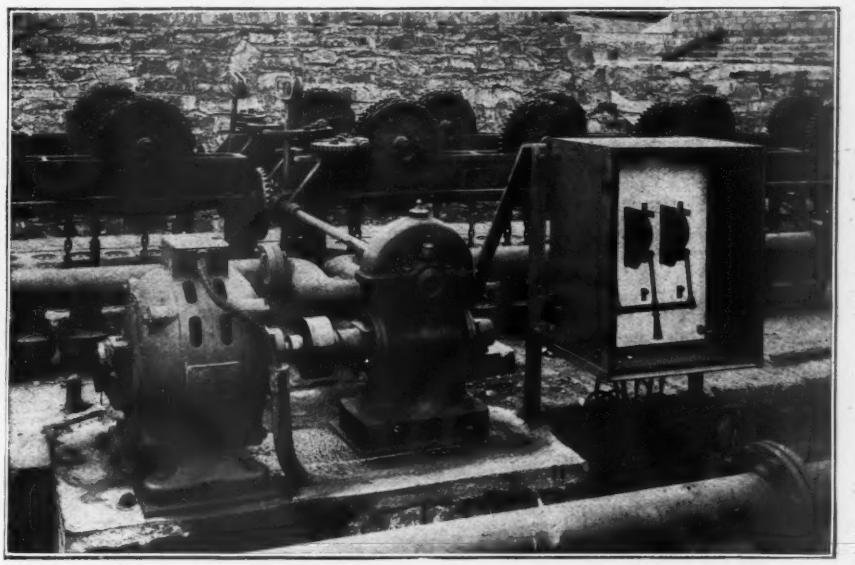
The steam-raising plant consists of four 30 ft. × 9 ft. Lancashire boilers, by Tinker, Shenton & Co.; these are arranged beside the engine house. The working pressure is 160 lb. per sq. in., and the steam is superheated 150° F. by means of Sugden superheaters. Both condensing and feed water is obtained from a pond situated a short distance from the engine house, there being a head of water of some 50 ft.

For boiler feed purposes the water, after being treated in a softening plant, is dealt with by two Weir single cylinder double-acting feed pumps, each capable of supplying 3,000 gal. per hour, also by a Körting injector with a duty of 1,250 gal. per hour. The feed water is initially heated in a Green economiser; the scraper gear on the latter is driven by a Siemens 3 B.H.P. motor, which, with its water-tight control panel, we illustrate.

The boilers are hand fired, and being close to one of the pit heads, no conveying plant was required.

All the steam and feed piping is of solid-drawn mild steel, supplied by Babcock and Wilcox; an auxiliary steam main is provided for supplying the feed pumps, &c., and all the steam and feed piping, boilers, &c., the latter being out in the open, are lagged with asbestos non-conducting composition.

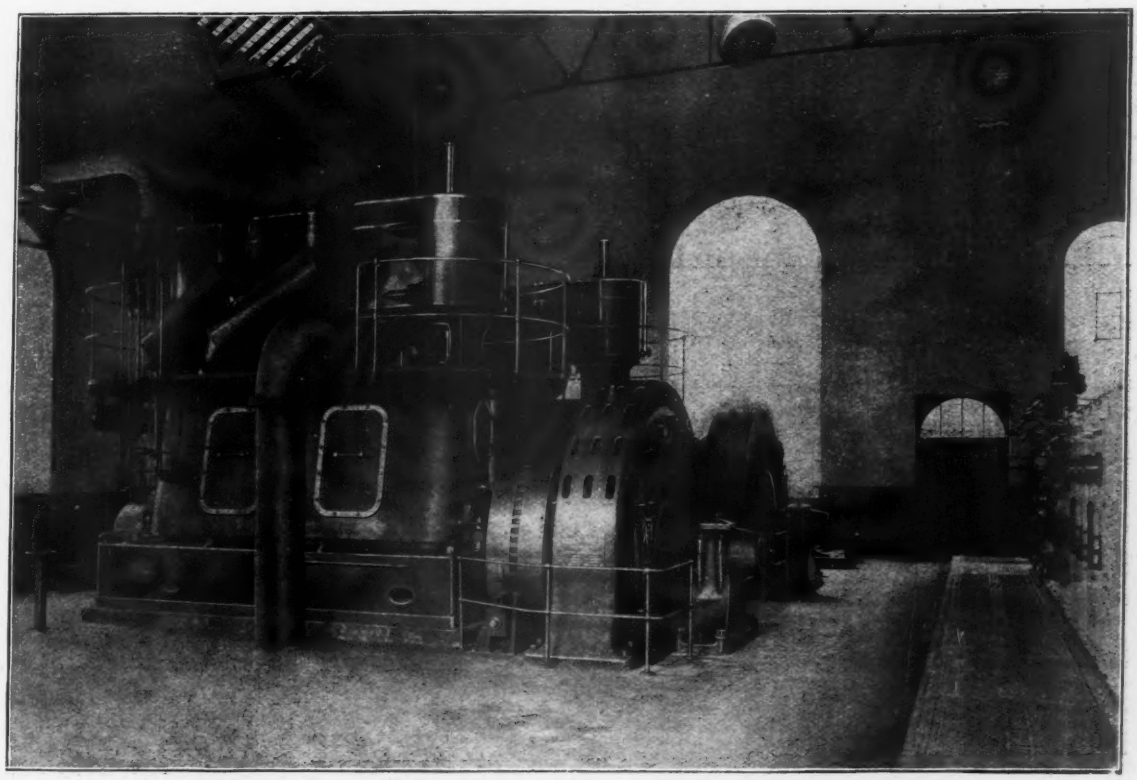
The engine house is a lofty stone building built by the



Siemens Motor and Watertight Switch; Economiser Scraper Gear.

1,000 K.V.A. Siemens-Bellis sets, generating three-phase current at 2,200 volts pressure and 25 cycles. The normal speed of these units is 250 R.P.M.; steam tests showed a consumption per KW.-hour at full load of 17·3 lb., and at half load of 18·6 lb. of steam. The sets are designed for an overload of 25 per cent. for two hours and momentary overloads of 50 per cent.

The Siemens alternators are of the rotating field type, the phases being star-connected. They have a continuous rating of 750 KW. at a power factor of 0·75.



View of the Generating Plant, Cambrian Collieries, showing Switchboard on the Right.

Colliery Co.; it is spanned by a 15-ton hand-operated travelling crane, and lighted by enclosed type arc lamps.

The generating plant arranged for consists of three units, two only being installed in the first instance; these are each

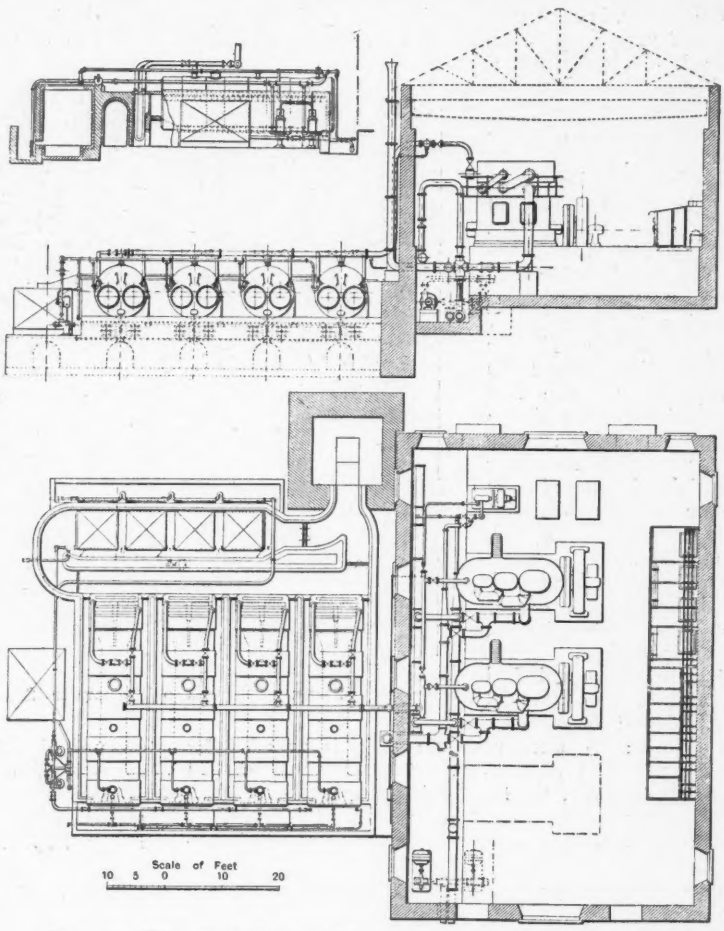
Each alternator stands on an independent bed, and is split horizontally so that the upper part of the armature may be readily removed, if necessary, by the overhead crane in the engine house. The rotor is directly bolted to the

engine fly-wheel; the armature coils, placed in open slots, are firmly held in position by wooden wedges, and the end connections are well supported to prevent distortion from heavy currents.

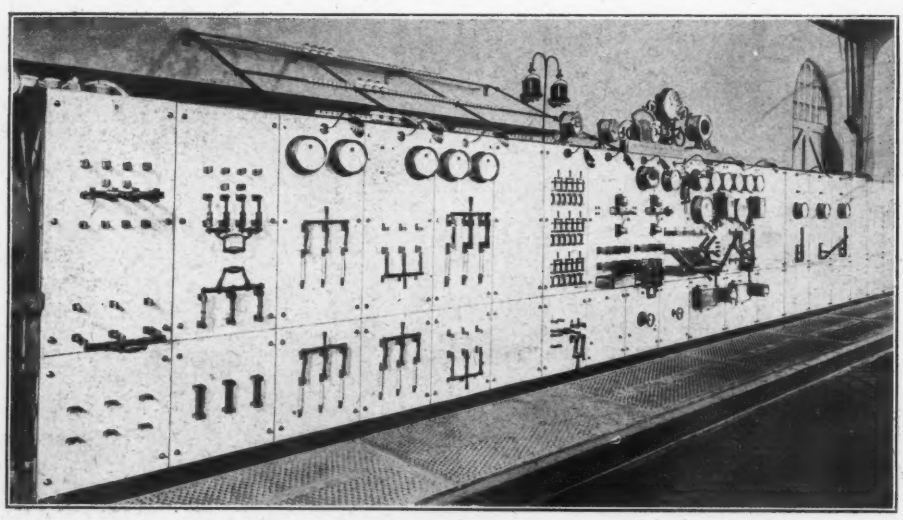
As previously mentioned, direct current for auxiliary purposes is supplied by a 36-KW. steam-driven generator and two 70-KW. motor-generators. The engine of the steam exciter is of the Belliss type, and runs at 600 R.P.M.

The two main engines exhaust into Körting ejector condensers, placed in the basement, each capable of dealing with 13,000 lb. of steam per hour, and producing a vacuum of 26 in. A smaller Körting condenser, capable of maintaining the same vacuum when condensing 1,000 lb. of steam per hour, is provided for the steam exciter. The exhaust piping and valves, supplied by Körting Bros., are so arranged that any one of the condensers can be shut down without interruption to the service. The condensers discharge into a tank from which a motor-driven centrifugal pump lifts the water back into the storage pond. The pump-motor is a Siemens three-phase squirrel-cage ventilated type 40-H.P. motor, fed with current at 25 cycles per second from the 400-volt alternating supply.

The switchboard, which is erected at one end of the engine room, is built of fire-proof material throughout. The operating panels contain only low-tension instruments and apparatus, and the high-tension oil switches are operated from them by a suitable system of levers. The operating board is separated from the high-tension gear by a passage with a clear width of 3 ft. 6 in. There are three alternator panels, one being blank, and six feeder panels, of which three have been fitted up with apparatus so far. Each of the two motor-generators is controlled from one continuous-current and one alternating-current panel. There is also a lighting panel in the centre of the board, an exciter panel, three transformer panels, and a number of blank panels are provided. The equipment includes low-tension integrating watt-hour meters with the requisite potential transformers, single-phase high-tension fuses, synchronising gear, an electrostatic leakage indicator to indicate a fault developing on any one of the three phases, overload releases with time-limit relays, and so on. The secondary windings of all instruments, as well as the switchboard frame and screens, are permanently earthed. The bus-bars are carried above the high-tension chambers on porcelain insulators.



PLAN AND ELEVATION SHOWING ARRANGEMENT OF CAMBRIAN COLLIERIES POWER PLANT.



GENERAL VIEW OF THE SWITCHBOARD.

Access to the rear of the operating board can only be obtained through expanded metal doors.

The high-tension panels next the wall are separated from one another by slate divisions, and the front of each panel (or chamber), is protected by a metal screen, so arranged that it cannot be removed until the isolating switch has been opened, thus cutting out the apparatus in question. All the operating panels are of white marble, supported on an iron framework.

The step-down transformers (2,200—400 volts), for supplying the surface and auxiliary motors, are arranged at one end of the switchboard.

The whole of the plant is of modern type and arrangement; it was formally inaugurated on Tuesday, July 9th.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—Dewsbury Corporation Lighting Committee has appointed Mr. ROGERS, of Warrington, as chief assistant engineer at the E.L. works.

Mr. FRANCIS BARRITT HILLS, A.I.E.E., has been appointed engineer to the North of Scotland Electric Light and Power Co., Montrose.

General. — Mr. T. W. SHEFFIELD, A.M.I.E.E., A.M.I.M.E., on resigning his position with Messrs. Crompton and Co., Ltd., for whom he acted as district manager for the whole of the North of England, was presented by the staff with a loving cup and a silver cigar case. The presentation was made by Mr. C. M. Davis, A.I.E.E.

Major W. O'MEARA, engineer-in-chief to the General Post Office, has joined the council of the British Fire Prevention Committee.

We are informed that Mr. C. H. ROSOMAN has resigned his position with the British Thomson-Houston Co., Ltd., Rugby, and has joined the firm of W. F. Jones & Co., manufacturers of switchgear, of Dacre House, Victoria Street, Westminster, S.W.

Mr. PAKENHAM W. BEATTY is sailing for Buenos Ayres as electrical engineer to the Buenos Ayres and Pacific Railway Co. on Friday, the 26th inst. He takes this opportunity of bidding farewell to his many engineer friends.

NEW COMPANIES REGISTERED.

Associated Battery Co., Ltd. (94,179).—This company was registered on July 15th, with a capital of £25,000 in £1 shares, to acquire the business carried on by the Amalgamated Dry Batteries, Ltd., to adopt an agreement with C. H. Elliott, and to carry on the business of manufacturers and vendors of electric batteries and other articles, &c. The first subscribers (each with one share) are:—F. H. Rogers, 16-17, Devonshire Square, E.C., patent agent: C. H. Elliot, Mid Kent Works, Penge, S.E., battery manufacturer; A. J. Aitkens, 20, Mark Lane, E.C., colonial broker; L. F. Goodricke, Moorgate Station Chambers, E.C., chartered accountant; J. S. Colman, Moorgate Station Chambers, E.C., chartered accountant; W. C. Goulding, 49, Finsbury Pavement, E.C., solicitor; and F. W. Davies, 3, Kemeys Street, South Hackney, managing clerk. No initial public issue. The number of directors is not to be less than two or more than five: The first are A. J. Aitkens, C. H. Elliot and F. H. Rogers; qualification, 250 shares; remuneration, £50 each per annum. Registered office, 16 and 17, Devonshire Square, E.C.

Pyrenees Electrical Society, Ltd. (94,225).—This company was registered on July 17th, with a capital of £60,000 in £1 shares, to promote, construct, equip, maintain, work and control roads, tramways, railways, motorways, telegraphs, telephones, cables, ships, lighters, piers, harbours, reservoirs, embankments, mills, smelting, hydraulic, gas, electric lighting and power supply works, &c. The first subscribers (each with one share) are:—L. P. Harris, 185, Crofton Park Road, Brockley, S.E., engineer; J. Drew, 69, Glamorgan Street, S.W., secretary; C. S. Goodwyn, Salisbury House, E.C., secretary; K. Cloake, Strathmore, Grove Park, Denmark Hill, S.E., traveller; G. R. Parkinson, 28, Mark Lane, E.C., salesman; W. A. Reed, 18, Allestr e Road, Fulham, S.W., clerk; and F. Hobbs, 88, Sugden Road, Clapham, S.W., traveller. No initial public issue. The first four directors appointed shall be life governors. Registered office, Parliament Mansions, Victoria Street, Westminster.

Scottish Electropathic Institute, Ltd. (6,580).—This company was registered in Edinburgh on July 20th, with a capital of £1,000 in £1 shares, to carry on electropathic treatment of human ailments. The first subscribers (each with one share) are:—P. Taylor, 65, Marlborough Avenue, Broomhill, Glasgow, retired draper; J. Macpherson, 25, Queen Street, Govan, Glasgow, manufacturing chemist; J. Wilson Hendry, 163, Hope Street, Glasgow, solicitor; T. Campbell, 163, Hope Street, Glasgow, accountant; R. Park, 57, Granville Street, Glasgow, clerk; J. Kelly, 120, Bowman Street, Glasgow, clerk; and J. G. Crawford, Erskine Villa, Alloa, clerk. The number of directors is not to be less than two or more than five; the first are P. Taylor and J. Macpherson. Registered office, 7, India Avenue, Glasgow.

Wireless Telephony (Entertainments) Co., Ltd. (94,195).—This company was registered on July 15th, with a capital of £1,500 in £1 shares, to adopt an agreement with F. E. Brown and H. F. Rogers, and to carry on the business indicated by the title. The first subscribers (each with one share) are:—H. F. Rogers, 229, Balsall Heath Road, Birmingham, engineer; E. P. Major, 3, Temple Row West, Birmingham, chartered accountant; F. E. Brown, 37, Beaconsfield Road, Birmingham, engineer; F. Sadgrove, Station Road, Acocks Green, Birmingham, clerk; G. H. Coxon, 36, John Street, Smethwick, electrical engineer; F. R. H. Corfield, The Hurst, Alexandra Road, Acocks Green, Birmingham, mortgage broker; and W. Wood, 3, New Street, Birmingham, consulting engineer. No initial public issue; registered without articles of association. Registered office, 4, International Exchange, Edmund Street, Birmingham.

Auction Sale.—Mr. G. F. Lockwood will, on Tuesday, July 30th, offer for sale by auction, at Low Harrogate, a stock of electrical fittings and appliances, under deed of assignment (*re* Ward, Barker & Co.). For further particulars see our business pages.

Grimsby and British-made Cables.—The Corporation E.L. Committee at its last meeting considered the purchase of cables. Some time ago tenders were invited with the result that a foreign manufacturing firm quoted the lowest price—some £200 less than the nearest British competitor. Prices were made public, and later the British firm wrote suggesting that they would amend their price if allowed, and pointing out that every order placed abroad was "a nail in the coffin of the British electrical manufacturing industry." Upon a vote of the committee being taken six voted in favour of the foreign firm, and six favoured the English tender. The Chairman, saying "I'm an Englishman," gave his casting vote for the latter. There was a good deal of further discussion, and it was ultimately decided to advertise again for tenders limitin competition to British firms supplying British-made cables.

CITY NOTES.

Thomas Parker, Ltd.

THE directors' report for the year ending April 30th, 1907, says that the amount standing to the credit of the profit and loss account is £18,033, which it is proposed to deal with as follows:—To add to the general reserve fund £5,000, to put to a depreciation reserve fund £5,000, to write off the suspense development account £3,500, and to carry the balance of £4,533 forward. The patent "C" type dynamos and motors which were put on the market last year have proved very successful, and have become the company's standard type, replacing all previous designs. The orders for electrical work have increased by nearly 50 per cent. over the previous 12 months, but owing to the continued competition and over-production, prices for electrical machinery have shown little tendency to rise, whereas the prices of raw material, especially copper, have been maintained at a high figure. The developments indicated in the half-yearly report have made exceedingly satisfactory progress during the six months. The Rees Roturbo Development Syndicate was formed and is now a very valuable property. The agreement between Thomas Parker, Ltd., and the Rees Roturbo Development Syndicate secured the full manufacturing rights in Great Britain for Thomas Parker, Ltd., in all classes of pumps, turbines and machinery under the "Roturbo" patents. The result of the sale of the patents to the Rees Roturbo Development Syndicate, Ltd., is a profit balance of £17,738 after writing off the whole of the formation expenses and the preliminary expenses of developing the business in the works. A large number of engineers have inspected these pumps and made exhaustive tests, and their opinions have been universally favourable. When particulars were sent to the shareholders of the formation of the "Roturbo" Co. there were only three patents applied for. Since then these have been granted by the Patent Office and published, and beyond these a number of development patents on the "Roturbo" principle have been filed, extending the control of the "Roturbo" in various directions, where there will undoubtedly be a large demand for plant of this description. The increase of orders for the pump since publication of details has been rapid, and the shops are accumulating patterns and standardising sizes as quickly as possible. The report contains a list of patents applied for, for which Thomas Parker, Ltd., have the sole British manufacturing rights. The directors not only consider that the prospects of the company are very satisfactory, but, owing to the development of sales and margin of profit in the Roturbo business, are more than satisfied that the company can look forward to occupying a place in the front rank of successful manufacturing concerns in the country. As will be seen from the above, the base of the business has been greatly enlarged, and the company is no longer dependent on one branch of engineering. In order to realise fully the advantages secured by the patents it is desirable to increase the capacity of the works so as to standardise rapidly and manufacture all the "Roturbo" machinery without interfering with the electrical output. With this object in view the directors intend to call an extraordinary meeting of shareholders to authorise the issue of fresh capital with the object of paying off the bank overdraft, redeeming the debentures and providing further working capital. The directors deem it advisable to deal with this matter at an extraordinary general meeting when they will produce complete proposals. The directors report the death last April of Mr. R. Armistead, a director. Mr. G. Balfour was elected to fill the vacancy. The directors propose to increase their number from four to five, and with the object of strengthening the technical side of the board they propose that Mr. W. Armistead be elected a director.

[The profit and loss account shows a balance of profit on trading account of £1,433, and a profit by sale of patents amounting to £17,738 received in fully paid shares. The balance of £18,033, which is allocated to reserve, depreciation, suspense development account, and carry forward as above, may thus be regarded as represented almost entirely by shares in the Rees Roturbo Development Syndicate. The balance-sheet shows that there is due to sundry creditors £12,437, due to bankers £29,271, and loans on securities are £8,000. On the other side, sundry debtors stand at £20,813, stock in hand and work in progress at £34,838.]

Bombay Electric Supply and Tramways Co., Ltd.

THE second ordinary general meeting of this company was held on Wednesday at Winchester House, Sir Edward Sassoon, Bart., M.P., presiding.

In moving the adoption of the report (see ELECTRICAL REVIEW, July 19th, p. 109), the CHAIRMAN said that the balance on the profit and loss account was £41,900, after deducting all expenses chargeable to revenue, including repairs and maintenance. The interest on loans and debenture interest absorbed £28,056, leaving a balance of £13,843, which added to £3,163, the amount brought forward from the previous account, made a total of £17,006. From that sum they had to deduct the dividend on the 6 per cent. cumulative preference shares paid on August 15th, 1906, £9,014, and the dividend on the shares accrued to December 31st, 1906, £6,627, a total of £15,642; which left a balance of £1,363, which the directors recommended should be carried to the next account. With regard to the balance-sheet, the capital expenditure up to December 31st, 1906, amounted to £1,229,349, including the payment of the balance of the purchase price of all property, works and other assets acquired under the agreement of July 3rd, 1905, and there had been an additional outlay of £120,951 on account of the reconstruction of the tramways, and £918,898 on accoun-

of power station and electricity plant. It would be noticed that they had advanced £24,407, bearing interest to contractors in anticipation of contracts falling due. Comparing the figures of this year and the year of the horse traction, it would be seen that the gross traffic receipts for 1904 were £100,901; 1905, £102,354; and in 1906, notwithstanding the dislocation of the service caused through reconstruction of the tramways, the traffic receipts amounted to £101,301. The first portion of the track from Colaba Terminus to Crawford Market, about 2·58 route miles, was opened in May, and a further section from Bori Bunder to Jamsetji Jeejeebhoy Hospital—1·81 route miles—was opened on June 1st, making 4·39 route miles working electrically. The receipts per car-mile for the period May 7th to June 7th earned by the electric cars averaged 13·85d., as against an average of 8·31d. per car-mile with horses, an increase of 5 per cent. It was satisfactory to note that the electric service had been free from any accidents. The former drivers of the horse-cars, after lessons in the company's workshops, soon learned to become efficient motormen. A portion of the reconstruction works had been temporarily stopped owing to the monsoon, but they could rest assured that as soon as the rainy season stooped the works would be pushed on as speedily as possible, and they hoped to have the whole of the work finished before the advent of the next monsoon. During the year under review the excess of expenditure over receipts in the electricity supply department had totalled £1,639, which brought that item up to £3,503, and they proposed to write that off as soon as the profits of that department would allow. They had every reason to believe that during the coming year the electric supply department would be a success. They had made installations at the Mint, the Post Office, and several large hospitals in Bombay. They had obtained an Act of License from the Governor dated April 18th, 1907, and also an amended Act amending the provision of the Bombay Tramways Act of 1874, so that the company had now got full powers to carry on their business. They believed they had a good field for development, and he could assure the shareholders that they held an interest in a highly promising business.

Sir CHARLES OLLIVANT, K.C.I.E., seconded the motion, and the report was adopted without discussion.

Direct United States Cable Co., Ltd.

THE directors' report just issued says that the half-year's revenue, after deducting out-payments, amounted to £57,056, as compared with £56,265 for the corresponding period of 1906, showing a difference of £791 in favour of the half-year under review. The working and other expenses for the same period, including income-tax, amounted to £24,699, leaving a balance of £32,357 as the net profit, making with £17,032 brought forward from the previous half-year, a total of £49,389. For the corresponding period of 1906, the working expenses and other payments amounted to £23,924. Three quarterly interim dividends of 4s. each per share, amounting to £36,426, have been declared and paid during the financial year, and a final dividend of 4s. per share is now proposed, together with a bonus of 2s. 6d. per share, making with the three interim dividends 4⅛ per cent. for the year, being a total distribution of £56,157. After transferring £15,000 to the reserve fund account, the balance of £2,516 is proposed to be carried forward. The reserve fund account has been debited with £4,184 for the cost of cable maintenance, and £40,000 provision on account of market depreciation of securities, and after being credited with interest on the investments, profit on sale of securities, and amount transferred from revenue, the balance now amounts to £491,968.

Crompton & Co., Ltd.

THE annual general meeting of this company was held on Wednesday, at Salisbury House, E.C., Mr. John Trotter presiding.

The CHAIRMAN, in proposing the adoption of the report (see ELECTRICAL REVIEW, July 19th, p. 107), said he had first of all to congratulate the shareholders upon the improved condition of things in the company. They were able to foreshadow something of the sort last year, but their expectations had been more than fully realised. The company's works had been very fully occupied. They had found it necessary during the year to carry out a further extension at the shops, and before those were well completed, they had been obliged to consent to a still further increase, which would take place during the current year in order to meet the requirements of their trade. The most interesting fact was that the net profit was £38,290, as against £20,000 last year. That figure was a record one, the previous largest amount having been in 1901, when it was £31,226, so that they had beaten anything they had done before by £7,000. He would like to explain why a sum of £6,572 had been deducted from the net profit. He told them last year that it would be necessary owing to a change in fashion to considerably write off old stock, which they intended to dispose of as well as they could, and at the best prices possible. They had got rid of that stock during the year, and had written off £6,572 without disturbing the amount carried forward. Last year they carried a large amount in order to provide for this, but fortunately they had been able this year to carry forward a triflingly larger sum as well as pay an increased dividend. They had to deal with £30,164, as compared with £13,372 last year. They proposed to declare a dividend at the rate of 5 per cent. per annum, which was double what they were able to pay last year. He thought it was a matter of congratulation that they had been able to get back to the good honest 5 per cent., which he looked upon as the minimum that any manufacturing company ought to pay. They were not very proud of it, and he did not think it represented anything like the dividend which the business ought to show, but in view of all the circumstances attending the electrical trade at the present time, he thought it was a matter of thankfulness that they had got back to the 5 per cent., and that at the same time they were able to carry a good sum to reserve. With regard to their holdings in the Electric Supply Corporation, it was no part of their business as manufacturers and contractors to hold investments in subsidiary companies permanently, nor was it the wish or the intention of the directors to do so. They were all aware of the conditions which had prevailed during the last few years in the money market. He did not think that the present condition of things was going to be permanent. He thought there were indications that a change was coming over the money market. The savings of the world would overtake the demand for capital, and investments now on the market would be gradually absorbed by the investing public. Till that time came, it was necessary for them to hold those investments, because they were good in themselves; the undertakings were sound; they had faith in them, and they were making excellent progress as far as new undertakings could. The progress of the Electric Supply Corporation was exceptionally good for a young company, and the number of lamps taken was very considerable indeed, and it was only a question of time before that company would be in a thoroughly strong and satisfactory position. They could not estimate the value of those shares at the present time, and therefore they put them in at the full amount, and carried a large amount to reserve in case their hopes were not realised. He had not the slightest reason for supposing that their hopes would not be realised, but it was always more prudent not to distribute money among shareholders until they were quite certain that they had got it in their pockets. It was for that reason that they had not declared a larger dividend, but, instead, had kept a considerable amount in reserve. Last year they had had a special investigation made of the two items, freehold property and tools and plant, and he had no hesitation in saying that the freehold land and premises, which stood at £68,686 in their books, were worth considerably more. As regarded the plant and tools, the figure last year was £82,997, and it was that figure they had had investigated, and their investigation showed that that item was worth considerably more than the amount at which it stood. During the year they had added £4,500 worth of new tools, so that the total at the end of the year would have been £87,522. In the ordinary course of things they would have written off £4,800, but this being a good year, they thought it better to deal very drastically with the figure, and so had written it down to £79,657. As to the stock-in-trade and work in progress, although they had done a considerably larger trade, they had managed to keep that down to practically the same figure as in the preceding year—£141,100, as against £141,800. Their trade debtors showed a very remarkable increase from £108,000 last year to £142,500; but he could assure them that the list was an exceptionally good one. The total amount of their bad debts last year did not amount to £500.

Colonel CROMPTON, in seconding the motion, said that the improved results were due to the gradual telling on their business of their engineering knowledge. Their officials had had many years of very hard times, with a gradual lowering of prices, and the one study that they had had before them for the last few years had been how to make both ends meet. They had done so in their contract work before, but never so in their manufacturing work as in the past year. They had succeeded in getting a profit in every department last year. The prices for electrical plant generally had not risen substantially, if at all, so that the profits had been made purely by economy of the most rigid nature, and by the utmost care in designing so as to use their materials as satisfactorily as possible. Their work had been done so well that in some cases they had succeeded in getting much higher prices than the market figure, simply on account of the excellence of their work, and the reputation of the firm.

The report was adopted.

Calcutta Electric Supply Corporation, Ltd.

AT an extraordinary meeting on 19th inst. it was resolved to increase the capital of the company to £1,000,000 by the issue of 100,000 additional shares of £5 each. The chairman said that new capital was continually being required to meet the development of the undertaking. At December last the total capital expenditure was £544,353, and the subscribed capital £500,000. They had recently had to order further generating plant, and the demand for additional mains extensions, and the number of customers continued to increase. From January 1st last to June 21st they had added more than 300 customers, the additional lamps attached to the system being an equivalent to 25,780 of 8 c.p., the total number of lamps at that date in connection with the mains being 289,174. The revenue had steadily kept pace with their increasing expenditure. It was difficult at present to say what the results were likely to be for the current year, seeing that the price charged for current had been reduced, and consequently there was for a time a natural reduction in the increase of income. The directors had no doubt that the reduction of price of current would bear fruit in the early future. They did not intend to issue more than £100,000 for some time to come. Their present intention was to issue £100,000 of preference shares in the autumn.

Bristol Tramways and Carriage Co., Ltd.—The directors have declared an interim dividend at the rate of 8½ per cent. per annum, for the half-year ended June 30th. The dividend warrants will be posted on Friday, August 2nd. Last year the interim dividend was at the same rate.

The Electric Construction Co., Ltd.

The annual meeting of this company was held on Thursday, July 18th, at Winchester House.

Mr. W. S. B. McLaren, who was in the chair, proposed the adoption of the report, and in doing so first referred with regret to the loss the company had sustained in the death of Mr. J. W. Barclay, the late chairman. He said the directors greatly regretted that the year's operations showed a loss of £1,442, but, in view of the late chairman's remarks at the last annual meeting, that result would not surprise them. It should, however, be noted that this loss was only arrived at after writing off £5,000 for general depreciation and about £2,000 for new tools and patterns in excess of the amount usually expended on such matters, and, in fact, treating the business in the most drastic way by charging everything to revenue which could properly be so charged, although many items might have been transferred to a suspense account, and written off over two, or even three years. The sundry creditors and bills payable amounted to about £52,000, as compared with about £50,000 last year. The general reserve fund had been reduced by £1,500, this sum having been transferred to sundry debtors reserve merely as a precautionary measure to provide for contingencies. £7,614 had been expended on additions to plant, which was strictly in the nature of new capital expenditure. This was almost exclusively on fixed machinery of the latest type, and as its installation had been followed by reduced cost of working, the directors considered this expenditure thoroughly justified. Shares in other companies had been increased by £18,893, representing a further allotment of preference shares in the Madras tramways in part-payment of the equipment of four miles of extensions supplied by this company. Sundry debtors were practically the same. Stock-in-trade and work in progress showed a diminution of £14,665, but they must not infer from this that they had less work on hand. It simply meant that last year they had more work near completion, but not yet invoiced, than they had this year, for the orders on the books were greater than they were at this time last year. The gross profit on manufacturing and contracting was £4,000 less than last year. Dividends on shares of other companies showed an increase of £744, chiefly from the Madras tramways. Their investment in the Electrical Power Storage Co. was thoroughly satisfactory, and continued to yield the same good dividend as before. On the debit side of the profit and loss account general charges and maintenance showed increases of £344 and £556 respectively. The former had been so well looked after during recent years that it did not seem possible to effect any reduction. The increase in the cost of maintenance depended on the necessities of the year, the directors being convinced that the best policy was to maintain everything in the highest state of efficiency. The result of all this was a net loss of £1,442, a result quite inconsistent with the hard work and anxiety which had devolved upon the board and the management. It was but small consolation to know that such absence of profit was not exceptional nor confined to that company, for he could not find that any electrical manufacturing concern of importance carrying on a purely manufacturing and competitive business similar to theirs could show any better result. In an article in the *Times*, dealing with electrical engineering trades, Sir Charles McLaren said:—"The manufacture of electrical machinery is overdone in this country. Rival firms cut prices and drive one another out of profitable business, while Swiss and German competition both at home and abroad, is keener than ever." Then, going on to speak of Messrs. Dick, Kerr & Co., of Preston, who showed a large annual profit, the writer said: "Much of this may, however, be derived from the operations of their general engineering works at Kilmarnock. This is probably one of the three dividend-paying electrical firms of any magnitude in this country; the other 12 return little or nothing to their shareholders." For the purpose of satisfying himself that undue competition was responsible for the present state of affairs, he had compared the average selling prices of the year 1903-4, the last year the company paid a dividend upon its ordinary shares, with those of the past year, and found that while the output of machinery had been approximately the same, the turnover in consequence of the slump in prices had been diminished by no less a sum than £28,000. He need hardly remind them that copper, the company's staple article of consumption, had increased in price since 1904 by 80 per cent., or £50 per ton. They would therefore recognise that if the methods of the company had not been progressive, and if the production had not be cheapened and strict economy exercised, the results would have been still more serious, but he was glad to assure them that they could produce as economically as any of their competitors, and that the standard of excellence for which this company was well known had not been in the slightest degree reduced. It was always dangerous to prophesy, and it was particularly so when an industry was suffering from over-production, but nevertheless he was justified in saying that at present the outlook was more encouraging. They had more work in hand than at this time last year, and at distinctly better prices. There was not so much evidence of a disposition on the part of manufacturers to accept work upon almost any terms, and if only reasonable selling prices could be maintained, they were confident that the company's former prosperity would be restored at no distant date. They had a very large and important order on hand from the L.C.C. in connection with tramways, and they had just secured a large contract amounting to well over £20,000 from an important firm in the Midlands in face of very vigorous German competition. As, however, they were well aware that keen competition in the electrical industry would continue, the directors had under their consideration the necessity of adopting further branches of engineering, and arrangements to this end had been made in one important direction, which, however, would not involve the company in any serious additional expenditure, and they had every reason to believe that their works would be kept fully employed. They were aware that the company was chief owner of the Madras tramways, and he need not remind them of the circumstances under which that property came into their possession. While they were satisfied that the tramways would ultimately yield a satisfactory return, its development had been slower than was anticipated. It was no part of their business to continue to hold all these shares, and they had just completed negotiations for a sale of a portion of their interest in the company.

Sir Henry C. Mance seconded the motion.

Dr. Drysdale said he was sure they all regretted that there was no dividend, but it was due to the fact of the excessive competition the company had to meet. He thought it would be a good thing if a few of the chief companies were to amalgamate instead of cutting each others' throats.

Mr. Prout remarked that the company seemed to him to be in very low water, and that they were not very far off from seeing the debenture-holders putting in a Receiver. Seeing that the shareholders had no dividend, he thought the board might at least forego half their fees.

Sir W. Plowden said he was not surprised that the shareholders were dissatisfied with the report. It was all very well for the chairman to talk of competition, but Crompton & Co., which was a very similar concern to theirs, had just issued its report, showing a net profit of £38,000, as compared with £20,000 a year ago. He suggested that there should be a small committee appointed by the shareholders to confer with the board.

The Chairman, in reply, said that amalgamation would be of little use, for it was impossible to think of forming a trust in connection with electric construction work in this country. They were perfectly ready to consider any fair scheme of co-operation with other companies—indeed, they had taken a very active part in an endeavour to fix standard rates for certain work, but, unfortunately, two of the large firms refused to come in, and so nothing could be done. With regard to the possibility of the debenture-holders appointing a Receiver, he could assure them that the company was a very long way off such a condition of affairs. The directors had worked well, and he could not see why they should be content with half fees. As a matter of fact, they were not taking as much as they were entitled to under the articles. Sir W. Plowden had referred to Crompton's, but he (the chairman) would remind them that that company was by no means on all fours with theirs. It was a company that did large general engineering work, and, in addition, it acted as a promoting company. He hoped the shareholders would not press the matter of a committee. If they were dissatisfied with the present board, let them appoint somebody else, but they would not share their responsibility with any committee of shareholders.

The report was then adopted, with three dissentients.

Anglo-American Telegraph Co., Ltd.

The directors' report says that the total receipts from January 1st to June 30th, 1907, including the balance of £1,147 brought forward amounted to £203,906. The traffic receipts show an increase of £2,200, as compared with the half-year ended June 30th, 1906. The working expenses of the half-year, as shown by the revenue account, amounted to £74,763, being a decrease of £5,461 as compared with the corresponding period of 1906. Quarterly interim dividends of 15s. per cent. on the ordinary stock, and of £1 10s. per cent. on the preferred stock, were paid on May 1st, 1907, absorbing £52,500, and second quarterly interim dividends of 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, amounting to £52,500, will be paid on August 1st, 1907. The balance of £24,143 will be carried forward. "The directors think it right to point out that the securities held on account of the renewal fund have further depreciated during the past half-year."

General Electric Co., Ltd.

The report of the directors, to be submitted at the meeting to be held to-day, Friday, 26th inst., states that for the year ended March 31st, 1907, the net trading profits and income from investments, &c., amount to £68,546. After deducting for depreciation and debenture interest £25,952, there remains a balance of £42,594, out of which the dividend on the preference shares at the rate of 5 per cent. for the year ended March 31st, 1907, has been paid, absorbing £12,500, and the directors now recommend the following appropriations:—Provision for managing directors and employés' bonus, £3,009; provision for dividend on ordinary shares at the rate of 5 per cent. for the year, £17,294; to reserve account, £9,791 7s. 10d. The reserve account stood at £108,578, being the amount of undivided profits as at March 31st, 1906. The proposed appropriation in the present report amounts to £9,791, giving a total of reserve account of £118,369. The prices of raw materials have continued to advance throughout the year, and have been the main cause of reduced trading profits. Their factories at Salford, Witton, Birmingham and London had again been increased by new buildings and more machinery; they have been maintained at high efficiency and are well filled with orders. The directors have recently concluded arrangements for working in Great Britain and Colonies the Osram tungsten metal filament lamp—from which they expect good results. Further ordinary shares to the number of 1,465 have been allotted during the period covered by the accounts to the directors and staff at par.

Last year the ordinary dividend was at the same rate; the amount carried to reserve was £12,325.

City and South London Railway Co.

The directors' report for the half-year ending June 30th, 1907, states that the receipts from all sources amounted to £82,456, and the cost of working has been £36,592, leaving a profit of £45,864. Inclusive of the balance brought forward from December 31st last, the net revenue account shows an aggregate total of £52,516. After making provision for the debenture stock interest, and the transfer to the renewal fund of £1,500, a balance remains available for dividend of £39,107. Out of this sum the directors recommend that the full dividend of 5 per cent. per annum be paid on the preference stocks, and that a dividend at the rate of 2½ per cent. per annum be paid upon the consolidated ordinary stock for the half-year, leaving a balance of £1,857 to be carried forward. The following table shows the number of passengers, exclusive of season ticket holders, for the last six half-years:—

Half-year.	Number of passengers (exclusive of season ticket holders).	Receipts (including season tickets).	Dividend per cent. per annum on ordinary stock.
December 31st, 1904	8,401,846	£70,706	1¾
June 30th, 1905	8,662,588	71,802	2
December 31st, 1905	8,607,486	70,104	1¾
June 30th, 1906	9,045,120	72,454	2¼
December 31st, 1906	9,104,293	72,298	2
June 30th, 1907	10,048,780	77,520	2½
Total since the opening of the line (in 1890)	180,177,381	£1,439,725	

The traffic on the old line and the old connections has shown a satisfactory increase, and the extension to Euston has brought in a considerable amount of new traffic. These receipts, added to what has come in from through bookings with allied systems, enabled the directors to recommend a dividend at the rate of 2½ per cent. per annum for the half-year, being an increase on the dividend for the corresponding period last year at the rate of ¼ per cent. per annum. The extension to King's Cross, St. Pancras and Euston was inaugurated on May 11th. This links up the company's line with the termini of the three great railways to the North of England, as well as with the two new—Hampstead and Piccadilly—tube lines. In particular, the new Hampstead tube connection gives access from the City and from the South of London to Golder's Green and Hampstead, as well as to Highgate, and to all the new stations intermediate between these points and Euston, where passengers get underground access to the City and South London system. The sidings at Stockwell, and the lift in connection therewith, are completed and in operation. The three new trains have been delivered and are running. The directors have not issued any of the capital authorised at the special meeting held on April 16th last. With a view, however, to adjusting the capital account and to meet the small additional capital required for other purposes, their intention is to take the first favourable opportunity of doing so in the way most advantageous to the company's interest. The directors place on record their regret at the loss the company has sustained by the death of Sir Benjamin Baker, who had been associated with the company from its inception.

The meeting is to be held on Wednesday, July 31st.

Edmundsons' Electricity Corporation, Ltd.

The directors' report (tenth annual) for the year ended March 31st, 1907, shows that the net profit after payment of debenture interest amounted to £16,595, which, with the sum of £15,212 brought forward from last year, made a total of £31,807. After deducting the dividend on preference shares paid to October 30th, 1906, amounting to £14,000, there remained a balance of £17,807, which the directors recommended should be carried forward to the next account. The directors regret that, owing to the slow development in the demand for electric light during the past year, the results have been so disappointing. They believe, however, that with the economies which may be expected from an extended use of the new high efficiency lamps and an increased demand for power purposes, an improvement will ultimately follow. The policy of the board as defined at the last general meeting has been to restrict the expenditure of capital as much as possible. The result of this is shown in the schedule of investments and advances, which have only increased by £37,599 as compared with an increase of £160,312 last year. The profit on trading account has necessarily diminished with the much smaller amount of work done, and after providing for all standing charges the net profit is only £4,059 as compared with £27,710 last year. In accordance with a suggestion made at the last general meeting, in addition to the usual list of holdings in the various undertakings, a schedule is given showing the earnings of each. The figures were obtained in spite of the continued severity of gas competition. Owing, however, to increased debenture and other prior charges of the subsidiary companies, this company's own income from these investments was only £31,136, against £32,182 last year. An improvement in this respect during the current year may be looked for. The directors regret to report that, owing to illness, Mr. H. Wolfenden has recently resigned his position of chairman and joint managing director and his seat on the board. Upon the request of a number of the larger shareholders, Mr. P. D. Tuckett has been elected to fill the vacant seat on the board, and the shareholders at the meeting will be asked to confirm this appointment. One of the directors, Mr. W. R. Davies, retires by rotation, and, owing to ill-health, does not seek re-election. The directors also, upon the request of a number of the larger shareholders, recommend that Mr. A. A. Campbell Swinton be elected to fill this vacancy.

Schedule Showing Capital Expenditure and Income of Subsidiary Companies for the Years 1905 and 1906.

Name.	Capital expended.		Profit.	
	Dec. 31st, 1906.	Dec. 31st, 1905.	1906.	1905.
Alderley	£45,727	£44,480	£1,309	£1,169
Bromley	148,637	144,906	10,825	9,287
Folkestone	187,249	176,945	11,262	9,899
Isle of Wight	256,284	250,328	9,501	8,537
Ilfracombe	30,763	29,536	283	733
Lymington	35,510	34,946	1,378	1,571
Melton Mowbray	39,815	39,280	1,622	1,286
Newmarket	38,462	38,072	2,045	2,096
North of Scotland	104,214	99,906	1,737	2,377
Ramsgate	33,100	32,074	698	105
Scarboro' Trams	99,499	97,463	1,118	1,747
Salisbury	70,402	69,395	4,828	4,830
Urban Co.	1,011,746	970,241	31,429	26,298
Winchester	86,622	84,777	6,291	5,389
Wycombe	99,174	97,598	4,219	4,215
Guernsey	128,359	127,768	4,412	4,437
Cromer	30,256	29,688	807	750
Dorking	35,849	34,263	1,511	1,473
Frome	49,856	45,679	767	730
Hamilton	57,038	52,991	1,325	1,726
Surbiton	54,270	51,786	2,038	3,057
Total	£2,644,832	£2,552,072	£100,360	£91,612

The lamps connected to the above systems increased during the year from 891,835 (8 c.p.) to 1,023,660.

Particulars of Investments in, and Advances to, Subsidiary Companies.

Company.	Shares.	Debentures.	Advances.
Alderley and Wilmslow Electric Supply Co., Ltd.	£3,856	£5,000	£37,401
Bromley (Kent) Electric Light and Power Co., Ltd.	23,100	—	—
Folkestone Electricity Supply Co., Ltd.	13,475	—	—
Isle of Wight Electric Light and Power Co., Ltd.	118,900	5,800	47,744
Ilfracombe Electric Light and Power Co., Ltd.	335	—	34,612
Lancashire Power Construction Co., Ltd.	85,800	—	—
Lymington Electric Light and Power Co., Ltd.	18,300	9,600	1,253
Melton Mowbray Electric Light Co., Ltd.	15,910	19,900	—
Newmarket Electric Light Co., Ltd.	5,650	8,000	—
North of Scotland Electric Light and Power Co., Ltd.	49,470	—	50,202
Ramsgate and District Electric Supply Co., Ltd.	320	—	37,670
Scarborough Tramways Co.	64,100	—	25,166
Salisbury Electric Light and Supply Co., Ltd.	24,919	20,000	—
Urban Electric Supply Co., Ltd.	296,820	—	212,468
Winchester Electric Light and Power Co., Ltd.	16,815	9,000	—
Wycombe (Borough) Electric Light and Power Co., Ltd.	31,160	33,700	21,752
	£708,930	£111,000	£468,268

Summary.

Shares	£708,930
Debentures	111,000
Advances	468,268
Investment in Guernsey undertaking	182,795
Investment in Cromer, Dorking, Frome, Hamilton, and Surbiton (local authorities) undertakings	29,713
	£1,450,701

Of the above investments, £416,344 has not yet reached a dividend-earning stage.

Chili Telephone Co., Ltd.

The meeting of this company was held on Thursday, July 18th, at 42, Old Broad Street, E.C.

Mr. George Keith presided, and in moving the adoption of the report (see Electrical Review, July 12th), said he was glad to be able to submit a favourable statement of the accounts for the 12 months under review. It had been a very exceptional year, and one of great difficulty for the company's business, owing to the disaster which took place on the evening of August 16th, and which caused great loss of life and property in the central portions of Chile, especially near the coast. The whole of the subscribers in the central district were disconnected, and most of the public buildings were seriously damaged and rendered unsafe. Fortunately their place escaped with comparatively small injury. Their general superintendent lost no time in taking steps in the unprecedented position to establish communication with Valparaiso. On his arrival there, he found everything in confusion, and that several of their employés had been killed in trying to escape from the central buildings, whilst others were missing. He immediately took steps to relieve distress and establish communication. A wooden shed—to serve as a temporary exchange—was put up by permission of the authorities, and an apartment opened to provide food for the sufferers. After alluding to the conspicuous services rendered in the matter by the staff, and paying a tribute to the exertions of the officials of the River Plate Telephone Co., he stated that within a fortnight of the disaster, telephone communication was again established in Santiago, and before the close of their financial year, March 31st, a large number of their

subscribers, who had been cut off by the disaster, were re-connected, and business resumed its normal condition. Throughout the country, business became again generally active and prosperous and the diminished number of subscribers at Valparaiso had, in a measure, been covered by the increase at their centre. The aggregate loss in subscribers for the year was 155. The company's property at their centre had also been extended. The cost necessary to meet the telephonic communication required —£4,011—had been carried to capital account. The increase shown in the revenue was partly due to increase of business at their centre, which was unaffected by the disaster, and partly by the higher rate charged in order to cover the heavy fall in the value of exchange, which came to £7,021. The total income, including interest on investments, amounted to £31,252, and after meeting all expenses and charges, and adding the balance brought forward from the previous year's account, there remained a balance for the year of £29,892. An interim dividend of £6,600 was paid in January, and £9,564 was carried to reserve. The directors now proposed a final dividend of £11 000, making a total distribution for the year of 8 per cent. on the shares free of income-tax, the same as for the previous year, and leaving a balance of £2,727 to be carried forward to the next year's account. Under the circumstances, he thought he must congratulate the shareholders on the increase in the year's business. Their recovery from the earthquake disaster had been, to say the least of it, most remarkable. Their business during the present year, so far as it had gone, continued to make satisfactory progress. The re-building of Valparaiso had been commenced on an improved plan. The work would necessarily be slow; but there was no doubt that when it was rebuilt, it would be a finer and more prosperous city than it was before the disaster.

The report was seconded by Mr. W. F. Jones, and adopted.

Shanghai Electric Construction Co., Ltd.

At the meeting of this company, held at 54, Old Broad Street, E.C., on 18th inst., Sir Alfred Dent, who presided, moved the adoption of the report (see Electrical Review, July 19th, page 107), and in doing so referred to the progress that was being made with the undertaking. An agreement with the company which obtained the tramway concession in the French Settlement had been come to under which they would have mutual running powers over their respective lines. The agreement was that the number of car-miles run by each company should be identical. As to the progress made by the French company, they expected to be ready early in 1908. Their cars were under construction in this country, and were exactly similar to this company's. With regard to the tramways on the Chinese Bund and in the Chinese quarter round the native city, negotiations appeared to be at a standstill, but when the Chinese authorities saw the tramways running successfully in the English and French settlements, they would desire to have them extended to their own streets. Regarding the anxiety of the small jinrickshaw men lest the tramway should destroy their living, he was more than confident that these men would find the advent of the tramway a blessing in disguise, and they would then earn their money more easily. Now that the capital was fully paid up and the works were in a very advanced state of completion, the directors recommended that the £1,000 shares should be split into 100 shares of £10 each.

Electric Supply Corporation, Ltd.

The directors' report for the year ended December 31st, 1906, says that the gross revenue shows a steady and satisfactory improvement, and, including the dividend from the Chelmsford Co., amounts to £7,285. After providing for debenture interest and other items shown in the net revenue account, there remains a net profit of £151. During the year the supply of electricity was commenced in Dumbarton, Hitchin and Falmouth, and 6,853 lamps had been connected to the mains in those towns. The dividend received from the Chelmsford Co. amounted to £1,873, notwithstanding a reduction in the price for energy and an additional cost which was incurred in providing increased illumination in the public lighting of the streets. The six towns, Jedburgh, Melrose, Dalkeith, Dollar, Exmouth and St. Andrews, produced a gross revenue of £3,730, compared with £2,061 in the preceding year. The Totnes undertaking is now working at a profit. The directors consider the growth of the business satisfactory. It will be seen from the figures below that in each town there has been a substantial increase in the number of lamps connected to the mains. The tramway within the burgh of Dumbarton has since been completed, and the line is now open for traffic. The provisional order for the tramway from Clydebank to Dumbarton, and from Dumbarton to Balloch, has been confirmed by Parliament, and it is proposed to transfer this order and the burgh tramway to a company which has been registered under the title of the Dumbarton Burgh and County Tramways, Ltd. A Bill, authorising this transfer, has been presented to Parliament. The new company will repay to the Corporation the costs incurred, together with the outlay on the burgh tramway, and will contract to take its supply of electrical energy from the generating station at Dumbarton at satisfactory prices. The Bill in Parliament for vesting in the Corporation the various undertakings constructed and worked by the Corporation is unopposed, and is expected to be passed into law next month. This will give legal effect to certain agreements with local authorities, and will put an end to the existence of separate companies for Chelmsford and Totnes. The guarantors having paid the sum necessary, a final dividend for the year 1906 was posted to the shareholders on January 14th last, and they will now provide the amount sufficient for the payment of an interim dividend at the rate of 5 per cent. per annum for the six months ended June 30th last. The dividend warrants will be sent to the shareholders on the 30th inst.

Statement of Amount Expended in Respect of the Various Undertakings of the Corporation.

Town.	Total capital expenditure to December 31st, 1906.
Carnoustie	£900
Dalkeith	14,616
Dawlish	403
Dollar	6,735
Dumbarton lighting	28,217
,, tramways	27,735
,, county tramways	5,115
Exmouth	26,807
Falmouth	25,574
Hendon	1,064
Hitchin	14,219
Jedburgh	12,870
Launceston	389
Melrose	10,154
St. Andrews	22,084
Sidmouth	471
Stevenage	255
Teignmouth	1,602
Chelmsford undertaking	59,161
Totnes ,,	13,554
Total capital expenditure	271,924
Total of preliminary expenses	15,998

The Following Generating Stations were Completed and in Working Order at December 31st, 1906:—

	Supply commenced.	Lamps connected. (Equivalent in 8 c.p.) 1906.	Increase lamps.
Chelmsford	1890	22,510	1,174
Jedburgh	1903	2,969	739
Melrose	1904	2,545	316
Dalkeith	1904	3,796	1,151
Dollar	1904	1,689	298
Totnes	1904	2,555	660
Exmouth	1905	4,742	1,992
St. Andrews	1905	7,993	4,791
Hitchin	April 1st, 1906	2,463	—
Dumbarton	April 13th, 1906	3,478	—
Falmouth	Dec. 7th, 1906	912	—
		55,552	

The Dumbarton Burgh tramways have been completed and opened for traffic since December 31st, 1906.

United River Plate Telephone Co., Ltd.

The annual meeting was held on Tuesday at Winchester House, Mr. J. Irving Courtenay presiding. In moving the adoption of the report (see Electrical Review, July 12th, p. 69), he said that the results of the year's working had fully justified the anticipations he expressed at the last meeting. Throughout the wide area in Argentina, extending from north to south, in which the company's operations were carried on, there was found to be a continuance of the satisfactory progress the company had made in the past, and why should not that continue? The population was rapidly increasing, and they had to make every effort to keep pace with the demands of the public in the more important cities like Buenos Ayres, Rosario, &c., and to provide for the wants of the near future. What these demands were likely to be might be indicated by the position to-day of the telephone business in some of the leading cities in older countries. They were actively engaged in Buenos Ayres in replacing their overhead lines by underground cables. Not only did it minimise the danger of loss and interruption through any large fire occurring, say, in a busy portion of the city, but it ensured a practical immunity from damage by storms. Each year, by means of the extension of their underground plant, possible trouble from this source was being removed, and as the cost of upkeep of underground cables was not anything like so high as the upkeep of aerial lines, the company would reap an advantage in the latter respect also, and its underground plant would more firmly establish it in the city. In Rosario and Cordoba also a considerable number of overhead lines had been replaced by underground cables, and it was their intention to make similar changes in other important towns. A further improvement was being effected by the installation of common-battery switchboards on modern principles to work in connection with the underground plant. One large board had been erected and two others were in course of erection in Buenos Ayres. Already there was a marked improvement in the service, which was much appreciated on the other side. The Rosario line had been opened for public service. This line, which was about 200 miles long, connected the city of Rosario and its neighbourhood with Buenos Ayres. The line tapped one of the richest grain-producing regions in the Argentine. The traffic was growing day by day, and would ultimately be an important source of revenue. They had thus connected the two important provinces of Buenos Ayres and Santa Fe, and it was now not only possible for the company's subscribers as far north as Rosario, and even beyond that point, or as far south as Chascomus, to communicate directly with the Federal capital, but through the Buenos Ayres offices these extreme points could be put into communication with one another, and thus subscribers to the company's system could talk over distances not much short of 400 miles, which, for South America, was a creditable record. Their relations with the Government and municipal authorities were of a friendly description, and as the country was becoming year by year more settled, they might look forward to a continuance of prosperity there. Argentina was developing in all directions. New industries were constantly being started, and there was no reason why the company should not continue to share in the prosperity by giving the community a thoroughly good service at a reasonable rate. With regard to the

future, a company like theirs could not stand still. They could not forecast the future with absolute certainty, they must look ahead and provide for the future in as intelligent a manner as possible; and as a basis for estimates of this description, they naturally went to the experience of others. The speaker went on to refer to the wonderful progress that had taken place in the United States. In the United States there was approximately one telephone for every 20 inhabitants; in the United Kingdom one for every 90; in Germany one for every 120; and in Argentina one for every 200. That would show the field they had to work, and the room for increase, and it also explained the reason of their expansion and constant need of new capital. The conversion of the 5 per cent. debenture stock into 4½ had been accomplished, and the company was now in an infinitely stronger financial position than heretofore. It was vital to the well-being of the company that adequate borrowing resources should exist. These resources did now exist, and would indeed keep pace automatically with any increase in the share capital. The extent to which in the future they might avail themselves of these powers would be dictated by circumstances. There would probably be an issue of ordinary shares in the late autumn of this year, and he had no doubt the terms would prove to be agreeable to the shareholders. Sir John Gavey, late Engineer-in-Chief to the Post Office, had joined the board of the company, and he was going out to South America this autumn for the purpose of making himself further acquainted with the business and affairs of the company. The visit would be productive of much benefit to the company. The capital had been increased by £100,000, by the issue of 20,000 new ordinary shares in July, 1906. There was a considerable increase in the sundry creditors, which was accounted for by large purchases in connection with their underground work, the installation of the common battery system, and the general extension of business. They had added £10,000 to their reserve fund and £25,000 to renewal of plant account. These reserves were most essential for the stability of the business. New capital expenditure made it imperative to keep an adequate ratio between capital expenditure and reserves. The capital outlay for the year, apart from real estate, had been £116,483. This consisted of outlay in connection with the underground work, the installation of the common battery switchboards already referred to, and expenditure on new subscribers' lines and instruments. The increase in the net profit for the year was £14,008. The directors recommended a final dividend of 5 per cent. on the ordinary share capital, making, with the interim dividend, 8 per cent. for the year.

The motion was seconded by MR. FRED. GREEN.

A SHAREHOLDER asked whether they anticipated any formidable competition, and whether the reserve was invested in the business with the exception of the amount against securities (£58,000).

The CHAIRMAN said that the sum named was invested in good class securities, and the rest was in the business. They had always had competition. This was not an age of monopolies, and it was perfectly certain that if they had not competition they would pretty soon have it, but small competitors were finding out that it took a long while to establish a telephone business. They had competition, and would probably have more, and they would meet it by giving the best possible service.

Mr. F. Green was re-elected a director, as was also Sir John Gavey.

The auditors having been re-elected, the CHAIRMAN moved a vote of thanks to the local board, the manager and staff in Argentina, and the staff in London.

Sir JOHN GAVEY, in seconding, said it must be obvious that to manage a concern like theirs, in which the base of operations was several thousands of miles away from headquarters, the London board was very largely dependent upon the loyal co-operation, energy, mastery of details, and the tactful handling of many delicate questions, of the local board, and their able and zealous officers who represented them in the Argentine. He had had the pleasure of making the acquaintance of some of them, and he hoped shortly to get into close touch with the whole of them. He could speak very warmly of the manner in which the local office here was conducted by the secretary and his staff.

A vote of thanks to the Chairman and directors closed the meeting.

Metropolitan Railway Co.

THE directors' report for the half-year ending June 30th, 1907, states that the total receipts (deducting this company's proportion of the revenue of the City lines and extensions) have been £345,519, and the expenses £193,361, leaving a profit of £152,158. Compared with the corresponding half-year of 1906 (when the receipts included for three months the earnings of the line north of Harrow which is now joint), the receipts show a decrease of £43,495, and the expenses a decrease of £19,671. The net revenue account, after providing for the interest upon the debenture stocks and other fixed charges and the dividend upon the preference stocks, shows a balance of £17,624 available for dividend upon the ordinary stock. The directors accordingly recommend the proprietors to declare a dividend upon the ordinary stock, for the past half-year, at the rate of 10s. per cent. per annum, and to carry forward £3,294. The first three months of the half-year compare with a period prior to the coming into force of the agreement with the Great Central Co. and the partial diversion of their traffic from the Metropolitan to the new Great Central and Great Western joint line. The falling off in revenue is due partly to this cause and partly to the competition from the tube railways and motor-omnibuses. The Surplus Lands Committee announce that the dividend on the surplus lands stock, for the past half-year, will be at the rate of £2 15s. per cent. per annum. By arrangement with the District Railway Co. and the tube railways, the fares by the Hammersmith and City line from Hammersmith, and from other stations in the west of London to the City were advanced on July 1st, and the effect on the receipts since that date has been satisfactory. It was felt that the fares had, in many instances, fallen to an unremunerative level, and that concerted action on the part of the carrying companies concerned was necessary in order to restore the fares to a more reasonable basis. Throughout the half-year the working of the electrical plant and machinery has given every satisfaction, and "the current is being produced at a very low cost per unit." The increased services of trains on the Circle and on the St. John's Wood line have been greatly appreciated by the public, and in the latter case have assisted the company materially to meet the motor-omnibus competition. The company's Bill to provide for the establishment of a pension fund for their wages staff has received the Royal Assent. The passengers carried during the half-year numbered 48,806,979. The half-yearly meeting was to be held yesterday, Thursday. The miles worked were 81 miles 76 chains, including 4 m. 17 f. foreign lines worked over. The statement of train-mileage is:—

	Half-year to June, 1906.	Half-year to June, 1907.
Steam passenger trains	572,840	197,718
Electric passenger trains	729,325	880,132
Goods and mineral trains	96,338	95,654
	1,398,503	1,173,504

National Telephone Co., Ltd.

MR. GEORGE FRANKLIN presided at Hamilton House, E.C., on Tuesday over the meeting of the above company.

In moving the adoption of the report (see ELECTRICAL REVIEW, July 19th, p. 107) the CHAIRMAN first referred to the lamented death of Mr. W. E. L. Gaine, the general manager, and said that the arrangements for the future were that the board had asked him to accept the post of president, and he had felt bound to respond by placing such ability and energy as he possessed at the service of the company. The accounts presented to them were in the nature of an interim report. The figures for the first five months were absolutely correct, but the figures for June were estimates. They would find that the income accruing in respect of the business of the half-year was £1,314,790, as compared with £1,195,151, or an increase of £119,639, which was a record increase in a half-year. Post Office royalties were £125,311, as compared with £113,348, an increase of £11,963. That left them with a net income of £1,189,478 as against £1,081,803, an increase of £107,675. The working expenses had been £753,207 as compared with £691,737, an increase of £61,469. The net result for the half-year was £436,271 as compared with £390,065, an increase of £46,205. The half-year's income represented the earnings of 428,703 stations, being an increase of 20,967 in the number of stations. In case they had not got the whole story in their minds he could convey it to them in a very few figures. First they had an increase in the income of £119,000 and an increase in the cost of earning it of £73,000, which left them with an additional income of £46,000. To that they had a diminished sum of £5,000 carried forward, which gave them £51,000 more for distribution. Of that £11,000 was absorbed in additional debenture and other interest; £30,000 in the increased dividend and dividend on new-issued capital; and £10,000 more had gone to reserves. A year ago he referred to the fact that owing to the adoption of cheaper tariffs the average income per station had for some years been gradually falling. In 1900 the average income per station was £7 11s. 8d., and since then year by year it had been gradually falling until last year it had fallen to what he hoped would be the bottom, viz., £6 3s. 7d. per station. He was glad to be able to say that the average income per station during the first five months of the year had risen to £6 4s. 5d., and from this figure they might predict that the decline in the revenue per station, owing to the adoption of these cheaper and popular tariffs, had at last been overcome by the increased users, and if that were so there was no reason why the company should not look forward to a period during the remainder of their tenure as prosperous as they had been having in the past, if not still more so. The percentage of working expenses had fallen from 63·94 to 63·32. Of the item of expenses: rents, rates and insurances had absorbed about £6,500 more; administration and management, £22,000 more; and maintenance of lines and instruments, £29,000 more. The last item was a somewhat special one, and was due largely to the fact that they had to make certain payments to the Post Office in respect of underground wires which had been put down for the company under an agreement, and for which last half-year they paid a rent of no less than £31,000. Had the company itself laid these lines, there would have been a charge for interest on the capital, but the expense would have been less. For the first time they had been able to recommend a dividend on the deferred stock at the rate of 6 per cent., the same as on the preferred stock, and he trusted shareholders would be satisfied that in doing so the board were doing their best in this matter of dividend distribution, always having in view a policy of prudence and the possibilities there might be in store for them. He thought the shareholders would think it satisfactory that they were able to do three things, viz.: (1) Pay a dividend at the rate of 6 per cent. on the new capital, which came in during the year; (2) increase the distribution to 6 per cent. on the old capital; and (3) to increase the payments to the reserve funds. He believed that these things would give the shareholders hope and confidence with regard to the future. They would notice that the total amount of capital spent, including

£658,000 on land and buildings, was £13,659,277. Of this, £10,516,000 had been raised by preferred, deferred shares and debentures, leaving a balance of £3,143,000, which was brought into the sheet representing the difference between capital expended and capital raised. The stock of materials which was always an item that shareholders had criticised, was £395,766, much the same as six months ago, and there was the item called "Special Replacement Account," which now stood at £129,895, as compared with £189,475. That item was being rapidly written off, and it represented the sum to be charged to revenue in respect of underground works which had been undertaken in many of the large towns. It was decided to spread the cost over a number of years, and they could see their way in 1909 to wipe it out altogether. Generally, on the whole of the accounts he could congratulate the shareholders on the comparatively smooth waters in which they now found themselves. It was true that they were face to face with great responsibilities, and that they had before them a somewhat anxious time when they reflected upon what might happen in 1911, but he could not help thinking that if they adopted a policy of financial prudence there was no reason for undue alarm or unrest. They could be assured that the directors were fully alive to the responsibilities which rested upon them, and would do their best with the opportunities which were presented to them from time to time. The staff which the company now had of 17,500, and the shareholders body of 16,600 persons, indicated the area and the extent of their business obligations, and it would impress on the shareholders that they had a responsibility in supporting the directors in the difficult task they had before them.

Mr. S. H. Sands seconded the motion.

Mr. Collins called attention to the fact that in the revenue account, administration and management, office salaries and charges, operators' wages, depreciation of plant and material, &c., were under one head of £369,505, and the item of maintenance and renewal of lines and instruments stood at £242,004. He suggested that the item for depreciation should be stated separately, so that they might really know what they had got in addition to the reserve. Last time they met, the Chairman quoted the clause of the Telephone Committee with regard to purchase, but he understood that the Committee did not accept that clause.

Mr. Stevens considered that the deferred shareholders were still being treated unfairly, inasmuch as the huge reserve fund which would probably by 1911 amount to £5,000,000, belonged to them. He suggested that they should issue some sort of script to be allotted to the deferred shareholders, so that, whatever the possibilities were, it would be certain they would get the benefit.

Mr. Lea Smith deprecated the discussion of such matters in public, and remarked that the directors would not have recommended an increased dividend without good grounds for doing so.

The Chairman hoped the shareholders would take the advice of Mr. Lea Smith, and leave the matter to those who were trying to steer the ship. They alone had the full knowledge at their disposal to form a sound judgment of what was prudent. If there were a surplus after arbitration in 1911, it would belong to the shareholders, and no power on earth could deprive them of it. The board would, however, go to the arbitration with greater confidence and lighter hearts if they had the reserve unfettered. He did not think it would be wise to show the depreciation separately.

The motion was carried and the retiring directors re-elected.

Mr. Fisher moved: "That, in consideration of the very large sum represented by the reserve fund and its prospective increase in the future, this meeting of shareholders is of opinion that before any further additions are made to the reserve fund, dividends at the rate of not less than 7 per cent. should be paid on the deferred stock, and recommends the same to the board of directors."

The motion found no seconder.

The Chairman said he could not help saying that Mr. Fisher did not understand the matter sufficiently. The peculiarity of that company was that day by day they were required to find fresh capital, and they had to raise it either from the shareholders or somewhere else. The more they paid away in dividends, obviously the more capital they must raise at the other end. The great strength of the company now and in the coming few years was in the holding of this large reserve. Without it their position would not be nearly so strong. He must say the board were in a difficulty in discussing the matter with the Press present, but the best advice they could possibly obtain had been obtained, and it was to the effect that as they had only a few years to run the reserve should be retained, for it would be a great strength to them when the time came.

Telegraph Construction and Maintenance Co., Ltd.

Mr. W. Shuter presided at the half-yearly meeting held at the offices on Tuesday. Owing to his slight indisposition, his speech was read for him by Sir James Pender. This said that at the meeting in February the directors reported that they were quite satisfied with the financial position of the company, and that they looked forward to the future with confidence. Since then everything had gone well, and nothing had happened which had caused them in any way to alter their views. They had carried out several contracts and had entered upon others which were still in hand. Perhaps the most important work of the half year had been the making and laying of a cable between New York, Cuba and Panama, a length of over 2,300 nautical miles. The contract for this cable was made in January last with the Central and South African Telegraph Co., of New York. They undertook to complete the entire cable on or before July 15th. Although the time was short considering the difficulty there had been in obtaining raw materials, and although the American Telegraph Co. increased the length of the cable, and requested them to lay some harbour cables which were in addition to the work contracted for, he was glad to say that they had received a telegram from their ship, the *Colonia*, saying that the laying of the whole line from New York to Panama was completed at 8 p.m. on July 15th, thus leaving four hours in hand before the expiration of the agreed time. It had always been the policy of the company to respect its contract dates, and it spoke well for the efficiency of their staff and organisation, both at the works and in their ships, that their contracts were carried out with such promptitude and success, and they all knew that work done quickly and well was done cheaply. The warrants for the interim dividend of 5 per cent. would be posted that day.

Mr. F. R. Lucas, a director, in replying to questions, said that the *Colonia* was a very large ship with a great carrying power, and they found that she could do her work so quickly that she could pretty well keep pace with the rate at which they could manufacture the cable. They found that they did not require two such large ships, and so they got rid of the *Anglia* some time ago. The *Cambria*, a slightly smaller ship than the *Colonia*, was employed in repairing and renewing certain cables in the Atlantic, and she was pretty constantly employed in that way. The board had considered the question of whether they should add to their fleet by building another ship, but there were always considerations to be studied. It was rather an expensive time to build, and they did not want to have more ships than they were likely to be able to keep in constant employment. That large telegraph companies had their own ships went as a matter of course. They had a large fleet of ships in all parts of the world, and that did not leave much work to be done by a company like this in the way of cables maintenance. They had another large contract for the *Colonia* to carry out as soon as she returned. It would involve a voyage to the Far East.

The meeting closed with the usual votes of thanks.

Central London Railway Co.—The directors recommend dividends at the rate of 3 per cent. per annum on the undivided ordinary stock, and 4 per cent. per annum on the preferred ordinary stock for the half-year ended June 30th last; also for a dividend at the rate of 2 per cent. per annum on the deferred stock, this latter dividend only being payable when the result of the year's working has been ascertained. £25,890 is carried forward.

St. James' and Pall Mall Electric Light Co., Ltd.—The directors have declared an interim dividend on the preference shares at the rate of 7 per cent. per annum, and on the ordinary shares at the rate of 10 per cent. per annum, for the half-year ending June 30th. These are at the same rates as last year's interim dividends. The share transfer books will be closed from July 25th to August 7th inclusive.

Newcastle-upon-Tyne Electric Supply Co., Ltd.—The directors have declared an interim dividend of 2½ per cent.

Hobart Electric Tramway Co., Ltd.—The directors have declared a dividend of 5 per cent.

Lancashire and Yorkshire Railway Co.—The directors recommend a dividend for the past half-year at the rate of 4 per cent. per annum, carrying forward £21,600. This compares with 4 per cent. last year, when £20,100 was carried forward.

Kensington and Knightsbridge Electric Lighting Co., Ltd.—The directors have declared an interim dividend on the ordinary shares for the half-year ending June 31st, 1907, of 5 per cent. Last year the interim dividend for the corresponding period was at the same rate.

Prospectuses.—*Electrical Distribution of Yorkshire, Ltd.*—A Bradford paper says that applications are about to be invited for subscriptions for shares in this company, which was incorporated in 1905 for the purpose of acquiring and working electric lighting provisional orders. The company has hitherto been concerned in electric lighting developments in many populous Yorkshire districts, all within the area of the Yorkshire Electric Power Co.'s area, and an agreement has been entered into with that company for a supply of power in bulk wherever possible.

Sumatra-Deli Rubber Estates, Ltd.—This company is making an issue of 85,000 shares of £1 each. It is to acquire estates on the East Coast of Sumatra, of some 8,767 acres, of which 1,500 acres are planted with rubber and tapioca. There are now over 350,000 rubber trees, of which 132,000, being six years old, are in course of tapping.

Dublin and Lucan Electric Railway Co.—The directors announce a dividend of 5 per cent. per annum on the preference shares, carrying £217 forward.

Dublin United Tramways Co., Ltd.—For the half-year ended June 30th the directors recommend a dividend at the rate of 6 per cent. per annum, carrying forward £6,615. Last year's dividend was at the same rate.

Imperial Tramways Co., Ltd.—An interim dividend has been declared at the rate of 8 per cent. per annum for the half-year ended June 30th. The dividend warrants will be posted on August 2nd.

Liverpool Overhead Railway Co.—The accounts for the past half-year show an available balance of £8,128. The directors have resolved to recommend payment of a dividend at the rate of 5 per cent. per annum on the preference shares which will absorb £3,676, and carry forward a balance of £4,452. Last year the dividend was at the same rate, and £3,797 was carried forward.

MARKET QUOTATIONS.

Wednesday, July 24th.

	CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	6/-	..
a	,, Nitric	per cwt.	22/-	..
a	,, Oxalic	per cwt.	28/-	..
a	,, Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a	,, ,, ...	per ton	£30	..
a	Bleaching powder	per ton	£5 10	..
a	Bisulphide of Carbon ..	per ton	£18	..
a	Borax	per ton	£15	..
a	Copper Sulphate	per ton	£33 10	..
a	Lead, Nitrate	per ton	£34	..
a	,, White Sugar.. ..	per ton	£35	..
a	,, Peroxide	per ton	£32	..
a	Methylated Spirit	per gal.	2/6	..
a	Potassium Bichromate, in casks	per lb.	3½d.	..
a	Potash, Caustic (75/80 %) ..	per ton	£30	..
a	,, Chlorate	per lb.	3½d.	..
a	,, Perchlorate	per lb.	9d.	..
a	Potassium Cyanide	per lb.	7½d.	..
a	Shellac	per cwt.	230/-	..
a	Sulphate of Magnesia ..	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a	,, Recovered	per ton	£5 10	..
a	,, Lump	per ton	£5	..
a	Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a	,, Chlorate	per lb.	3½d.	..
a	,, Crystals	per ton	£3 5	..
a	Sodium Bichromate, casks ..	per lb.	3d.	..
a	,, Cyanide (basis 100 %) ..	per lb.	7d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£200	..
b	,, Wire, in ton lots ..	per ton	£220	..
b	,, Sheet, in ton lots ..	per ton	£210	..
p	Babbitt's metal ingots	per ton	£60 to £105	..
c	Brass (rolled metal 2" to 12") basis	per lb.	9d.	1d. dec.
c	,, Tube (brazed)	per lb.	10½d.	1d. dec.
c	,, ,, (solid drawn)..	per lb.	9d.	1d. dec.
c	,, Wire, basis	per lb.	10½d.	½d. dec.
c	Copper Tubes (brazed) ..	per lb.	1/1½	½d. dec.
c	,, ,, (solid drawn) ..	per lb.	1/0½	½d. dec.
g	Copper Bars (best selected) ..	per ton	£112	£2 dec.
g	Copper Sheet	per ton	£114	£2 dec.
g	,, Rod	per ton	£112	£2 dec.
c	,, (Electrolytic) Bars ..	per ton	£102	£5 dec.
c	,, ,, Sheets ..	per ton	£110	£5 dec.
c	,, ,, Rod ..	per ton	£107	£5 dec.
c	,, ,, H.C. Wire	per lb.	1/0½	½d. dec.
f	Ebonite Rod	per lb.	8/8	..
f	,, Sheet	per lb.	8/-	..
n	German Silver Wire	per lb.	1/8	..
h	Gutta-percha, fine	per lb.	5/8 to 6/6	..
h	India-rubber, Para fine	per lb.	4/10½	..
i	Iron, Charcoal Sheets	per ton	£18	..
i	,, Pig (Cleveland warrants)	per ton	58/5	1/1 inc.
i	,, Forgings, according to size	per ton	From £11	..
i	,, Scrap, heavy	per ton	47/6 to 50/-	..
i	,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£22	dec.
g	,, ,, Sheet	per ton	£22 7 6	5/- dec.
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£6 16 to £7	..
d	Mica (in original cases) small ..	per lb.	6d. to 1/-	..
d	,, ,, medium	per lb.	2/6 to 4/-	..
d	,, ,, large ..	per lb.	4/6 to 8/6	..
p	Phosphor Bronze, plain castings	per lb.	1/4½ to 1/6½	..
p	,, rolled bars & rods	per lb.	1/5½ to 1/6½	..
p	,, ,, strip & sheet	per lb.	1/6 to 1/10	..
o	Platinum	per oz.	110/-	5/- inc.
e	Silicium Bronze Wire	per lb.	1/8½	..
	Steel, Magnet, acc'd'g to desc'p'n	per ton	£68	..
	,, in bars		£15 to £40	..
g	Tin, Block (English)	per ton	£185	..
m	,, Wire, Nos. 1 to 16	per lb.	2/4	..
p	White Anti-friction Metals—			
	"White Ant" brand	per ton	£56 to £80	..
k	Zinc, Sh't (Vieille Montagne bnd.)	per ton	£29 5	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Teleg. Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

Calcutta Electric Supply Corporation, Ltd.—The units delivered to consumers during the five weeks ended May 31st were 704,888 compared with 687,460 units last year; for the four weeks ended June 28th the number was 577,338 in 1907, and 538,356 units in 1906.

Anglo-Portuguese Telephone Co.—An extraordinary general meeting of this company was held on July 18th at 31, Budge Row, E.C., Mr. C. Woolley in the chair, when resolutions altering the articles which were passed at the annual meeting held on July 3rd were confirmed.

Montreal Light, Heat and Power Co.—A dividend has been declared for the three months ended the 31st inst., at the rate of 6 per cent. per annum.

STOCKS AND SHARES.

Tuesday Evening.

ANOTHER hiatus has occurred to check the course of Stock Exchange business which last week gave good indications of being on the mend. For one reason and another—and most of the causes are more vague than plausible—the volume of investment orders has contracted, followed by what would appear to be the inevitable result, a shrinkage in values. Weakness is once more apparent in many of the electricity supply issues, in spite of a batch of dividends satisfactory enough in the main.

Railway markets are decidedly dull, and here the generally-advanced explanation is the progress of Socialism at the polls, as exemplified in the results of the Jarrow and the Colne Valley elections. There are, of course, other forces at work, but this political stick is the one most in favour for beating the lame market. At present electrical railway stocks are fairly firm, a drooping of two points in City and South London being natural after the quick rise recently experienced. The report, out last Monday, reads well, but it contains a plain hint that more capital will be wanted before long, and this formed a convenient platform from which to push the price lower.

Incidentally, it may be hoped that the City and South London will give its proprietors the opportunity for subscribing to what new issue is made. The company in the past has been amongst those who occasionally sold blocks of stock privately, and in this practice it can claim precedents from the London and North Western, the Great Western, and certain other well-known railways. But, whatever advantages this system of obtaining money presents, it is one which rarely commends itself to the general body of proprietors, and for a long period it weakens the market in a way which is the reverse of desirable.

Central Londons had not changed up to this, Tuesday evening, but the dividend announcement is expected at any minute, and the estimates vary as much as 1 per cent., anything from 3 to 4 per cent. on the Ordinary being forecast.

From the Metropolitan Railway report it is clear that the directors are at last working amicably with the various underground lines, which shou'd act as important feeders to the senior system. The Ordinary stock at 46½ is rather lower on the week, and District Ordinary declined a point to 12½, despite spasmodic attempts at supporting the market. Underground Profit Notes maintain their improvement, the nominal price being left at 64-67.

Charing Cross Preference, Westminster Preference, Chelsea Ordinary and City Lights Preference are all down a little on the week. The two Debenture stocks of the City Company, however, are both better, and Metropolitan 3½ per cent. Debenture stock has been wanted, although the interim dividend is 3s., against 4s. a year ago. Edmundson's Ordinary changed hands at 10s. per share soon after the report appeared. Sharp criticism is directed at that document on account of the paucity of information afforded. It is argued that the directors would have done better had they taken their fellow shareholders into more ample confidence, and, in view of the condition into which the concern has drifted, had laid a full statement before the proprietors with regard to the position, earning capacity and prospects of the Edmundsons' chief properties. Possibly the board has delayed making a full statement until the meeting, and it is to be hoped that the audience will have the whole state of the case, with the reasons for the present deplorable pass, frankly elucidated.

Telegraph issues are very quiet. Anglo-American Deferred rallied, on the report, which does not state the amount of the depreciation in the list of investments. Eastern Telegraph Ordinary shed a point, and West India First Preference lost their ½ rise of last week. The same fate befell Globe Preference, and Great Northerns added the 10s. previously lost. Therefore, on balance, the list is roughly "as you were" a fortnight ago, the Anglo-American Telegraph Deferred stock showing the only material alteration. Marconi shares braced up 2s. 6d. to 13s. 9d., and several Debenture stocks are better. National Telephone 3½ per cent. Debenture has hardened ½, and quiet demand for Anglo-Portuguese Telephone Debenture—a stock always difficult to buy—raised the price a point to 102½, with very little of it on offer.

Traction shares are irregular. Anglo-Argentine Ordinary at 8½ improved again, notwithstanding the first notes of dissent with regard to the new proposals by which the shares become 10 per cent. Preference, and the Belgian syndicate takes a splendid profit for very little risk. Calcutta Trams were lower. There has been a little speculative buying of Potteries Preference at half a guinea, and later buyers had to pay 13s. 6d. British Electric Ordinary fell ¼, while the Preference rose twice as much, 2¾ and 7¾ respectively.

Brush Preference are 2s. 6d. lower, and Bruce Peebles Preference fell off to 3¾. Other manufacturing shares are firm, Crompton's being better at 2 1/16 and Babcock Ordinary at 4 middle. British Aluminium shares are hardly so good, while British Insulated Ordinary at 7 are again better.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations July 16th.	Closing Quotations July 23rd.	Business done week ended July 23rd, 1907. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3 — 3½	3 — 3½	..	..	..	Nil
149,800	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	5 %	5 %	86 — 89 xd	86 — 88	..	..	—1	5 13 8
660,660	Anglo-American Telegraph	Stock	61s.	2¾%	3½%	3¾%	62 — 65	62 — 65	..	..	..	5 19 3
3,169,670	Do. do. do. 6 % Pref.	Stock	6 %	5¾%	6 %	6 %	109 —110	109 —110	110	109	..	5 9 1
3,169,670	Do. do. do. Deferred	Stock	2s.	Nil	¼%	1¾%	20½— 21½	20⅝— 21½	20⅝	20⅛	+ ½	8 14 8
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	..	5 %	..	100 —1 3	101 —104	..	..	+1	4 16 2
44,000	Chili Telephone, Nos. 1 to 44,000	5	7 %	8 %	8 %	8 %	6¾— 7½	6¾— 7½	7⅛	..	..	5 10 4
2,097,680	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	92 — 94	92 — 94	93⅛	..	..	4 5 1
16,000	Cuba Telegraph	10	0 %	5 %	5 %	5 %	7½— 8½	7½— 8½	7⅞	..	..	6 1 3
6,000	Do. 10 % Pref.	10	15 %	10 %	10 %	10 %	15½— 16½	15½— 16½	..	..	..	5 19 5
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜— 3⅝	3⅜— 3⅝	..	..	..	5 8 6
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 %	8½— 9½	8½— 9½	..	..	..	5 8 1
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —101 xd	98 —101	..	..	..	4 9 1
60,710	Direct United States Cable	20	3 %	3½%	4½%	4⅝%	15½— 16	15½— 16	15⅞	..	..	5 19 6
57,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	98 —100 xd	98½—100½	..	..	+ ½	4 9 7
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	135 —140	134 —139	137½	136½	—1	5 0 9
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%	88 — 90	88 — 90	88	..	..	3 17 9
1,896,706	Do. 4 % Mort. Deb. Stock. Red.	Stock	4 %	4 %	4 %	4 %	103 —105	103 —105	..	..	..	3 16 2
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	13½— 13⅝	13½— 13⅝	13½	13½	..	5 2 9
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	104 —106	104 —106	..	..	..	3 15 6
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99 —102	..	..	+1	3 18 5
200,000‡	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	98 —100	98½—100½	..	..	+ ½	3 19 7
181,127	Globe Telegraph and Trust	10	5½%	5⅜%	5½%	5½%	10⅞— 11½	10⅞— 11½	11	10⅞	..	5 2 4
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	13⅜— 14½	13⅜— 14	13⅞	13⅜	— ⅛	4 5 9
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	24 %	24%	20 %	33½— 35½	34 — 36	35½	34½	+ ⅛	5 11 1
28,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	98 —100 xd	98½—100½	..	..	+ ½	4 9 7
17,000	Indo-European Telegraph	25	10 %	13 %	13 %	13 %	56 — 58	56— 58	..	..	..	5 12 1
$41,380,400	Mackay Companies Common	$100	..	1 %	2 %	3½%	66 — 68 xd	66 — 68	..	..	..	5 2 11
$50,000,000	Do. do. 4% Cum. Pref.	$100	..	4 %	4 %	4 %	67 — 69 xd	67 — 69	..	..	..	5 15 11
256,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	⅜— ⅝	⅜— ⅝	..	..	+ ⅛	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	4 %	5 %	..	1⅛— 1 1/16	1⅛— 1 1/16	..	..	..	4 14 1
86,492	Do. do. do. 5 % Pref.	1	5 %	5 %	5 %	..	⅞— 1	⅞— 1	..	..	..	5 0 0
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	109 —111	109 —111	110	109½	..	5 8 1
2,225,000	Do. do. Def. Stock	10	5 %	5 %	5 %	5½%	108 —110	108 —110	109½	108½	..	5 0 0
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	11¼— 13⅝	11¼— 13½	..	..	..	4 8 11
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	5 %	10 — 12	10 — 12	11	10¼	..	4 8 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5 1/16— 5⅛	5 1/16— 5⅛	5⅛	5 1/16	..	4 7 11
2,000,000	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	3 %	94¼ — 96½	95 — 97	96½	96	+ ½	3 1 10
1,689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	100 —102	100 —102	101½	100½	..	3 18 5
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6½%	6⅝%	7 %	7 %	1⅛— 1⅜	1⅛— 1⅜	..	..	..	5 1 10
50,000	Do. do. do. 6 % Cum. Pref.	1	6 %	6 %	6 %	6 %	1 1/16— 1 1/8	1⅛— 1 1/16	..	..	..	4 11 5
100,000	Do. do. do. 4 % Red. Deb. Stock	100	..	..	4 %	4 %	93 — 96 xd	93 — 96	..	..	..	4 3 4
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	97 —100 xd	97 —100	..	..	..	4 0 0
11,839‡	Reuter's	8	5 %	5 %	5 %	5 %	7 — 8	7 — 8	..	..	..	5 0
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	4½%	4½%	98 —101 xd	98 —101	..	..	..	4 10
3,167	Submarine Cables Trust	Cer	6 %	6 %	6 %	6 %	127 —130	127 —130	..	..	..	4 12 4
80,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	7 — 7⅞	7 — 7⅞	7 1/16	..	..	5 6 8
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 10 11
15,607‡	West African Telegraph, Shares	10	4 %	4½%	4 %	4 %	10 — 10½	10 — 10½	..	..	..	8 1 2
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2	Nil	Nil	Nil	2½%	1⅛— 1⅜	1⅛— 1⅜	..	..	..	3 12 9
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	97 —100 xd	97 —100	..	..	..	3 18 5
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930	10	7 %	7 %	7 %	..	13⅜— 14⅛ xd	13⅜— 14⅛	13⅛	13⅜	..	4 19 1
800,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	100 —103 xd	100 —103	..	..	..	3 17 8
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	⅜— ⅝	⅜— ⅝	10/6	..	..	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %	6 %	5 %	8 %	7⅛— 7⅝	7⅛— 7⅝	..	..	..	10 5 9
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	6¾— 7⅛	6¾— 7⅛	..	..	..	Nil
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	5 %	100 —103 xd	100 —103	..	..	..	4 17 1

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, Nos. 260,008 to 510,007, and 560,008 to 580,007	5	..	8 %	8 %	8 %	8⅛— 8⅜	8⅛— 8⅜	8⅜	8 1/16	+ ⅛	4 11 5
260,007	Do. 5½ % Cum. Pref., 1 to 260,007	5	5½%	5½%	5½%	5½%	6 — 6½	6 — 6½ xd	6 1/16	6 1/16	..	4 8 0
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	131 —134 xd	131 —134	..	..	..	4 9 7
285,106	Auckland E. Trams, 5 % 1st Mort. Deb. Stock	100	5 %	5 %	5 %	5 %	102 —105 xd	102 —105	..	..	..	4 15 8
830,000	Babcock & Wilcox, 1 to 830,000	1	17 %	20 %	20 %	0 %	3⅞— 4	3¾— 4⅛	78/9	77/6	+ ⅛	4 19 6
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000	1	6 %	6 %	6 %	6 %	1⅛— 1⅛	1⅛— 1⅛	..	..	+ 1/16	3 7 7
38,000	British Aluminium, Ord., 2,001 to 40,000	5	..	7 %	7 %	7 %	5 — 5⅛	4⅞— 5⅛	..	..	— ⅛	7 0 0
40,000	Do. do. 7 % Cum. Pref.	5	Nil	7 %	7 %	7 %	6¼— 6⅜	6 — 6⅛	6 1/16	..	— ⅛	6 7 3
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	6 %	5 — 5⅛ xd	5 — 5⅛	..	..	..	5 9 1
20,000	Do. do. 4 % Funding Certs.	5	..	4 %	4 %	4 %	3⅞— 4⅛	3⅞— 4⅛	..	..	..	4 14 1
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..	4 17 1
300,000	Do. do. 5½ % Loch Leven Debs.	100	..	..	..	5½%	98 —101	98 —101	99½	99½	..	5 8 11
400,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	6 %	6 %	123 —128	123 —128	..	..	..	4 13 9
300,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	108 —112	108 —112	111½	..	..	4 9 8
300,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	101 —104	101 —104	102¼	..	..	4 15 2
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	101 —103 xd	100 —103	..	..	— ½	4 5 9
133,301	British Electric Traction	10	6 %	6 %	3 %	Nil	2⅝— 3	2⅝— 3	3/6	..	— ⅛	Nil
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	7½— 7⅞	7½— 8	8	7⅞	+ ⅛	7 10 0
1,448,653	Do. do. 5 % Perp. Deb. Stock	Stock	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..	4 17 1
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	4½%	4½%	4½%	78 — 81	78 — 81	79⅜	..	..	5 11 1
100,000	British Insulated and Helsby Cables	5	8 %	8 %	8 %	10 %	6¾— 7	6⅞— 7⅛	7 1/16	6 15/16	+ ⅛	6 17 11
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅞— 6⅛	6⅛— 6⅜	..	..	..	4 16 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	101 —104	101 —104 xd	103	102½	..	4 6 7
212,000	British Thomson-Houston 4½ % 1st Mort. Debs.	100	4½%	4½%	4½%	..	89 — 93	89 — 93	..	..	..	4 16 9
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	..	1 — 1⅛	1 — 1⅛	..	..	..	Nil
1,016,353	Do. do. 4 % Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	58 — 63	58 — 63	..	..	..	6 7 0
50,000	Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	0 — 1½	0 — 1½	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	2½%	Nil	⅛— ⅜	⅛— ⅜	7/6	..	..	Nil
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	Nil	⅜— 1⅛	⅜— 1⅛	13/9	..	— ⅛	Nil
125,000‡	Do. do. 4½ % Perp. Deb. Stock	Stock	4½%	4½%	4½%	4½%	88 — 91	88 — 91	..	..	..	4 18 11
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	71 — 74 xd	71 — 74	..	..	..	6 1 7
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	3 %	4 %	3 %	3 %	4⅛— 4⅜	4⅛— 4⅜	86/-	84/4½	..	3 8 7
40,000	Do. do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	6 %	4⅜— 4⅝	4⅜— 4⅝	..	..	..	5 14 3
27,500	Do. do. "B" do., 1 to 27,500	5	6 %	6 %	6 %	6 %	4⅜— 4⅝	4⅜— 4⅝	..	..	..	5 14 3
13,200	Do. do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	105 —115 xd	105 —115	..	..	..	4 6 11
190,000	Do. do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	101 —103 xd	100 —103	..	..	..	4 17 1
137,610	Calcutta Trams, 1 to 137,610	5	6 %	8 %	8 %	8 %	7⅜— 7⅝	7⅛— 7⅜	7 1/16	..	— ⅛	5 4 11
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,380	5	..	..	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	..	..	— ⅛	4 8 11
350,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	102 —106	102 —106	104⅜	..	..	4 4 11
35,000	Callender's Cable Construction shares	5	12½%	12½%	15 %	15 %	9⅜ — 10⅛	9⅜— 10⅛	10⅛	..	..	6 13 4
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅜— 5⅝ xd	5⅜— 5⅝	5 3/16	..	..	4 8 11
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	105½—107½ xd	105½—107½	..	..	..	4 3 9
491,222	Cape E. Trams., 1 to 491,222	1	10 %	5 %	Nil	..	1/16— 1/8	1/16— 1/8	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %	8 %	1⅛— 1⅜	1⅛— 1⅜	25/6	..	..	6 1 11
224,998	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	..	97 —102	97 —102	99⅜	..	..	4 8 8
911,568	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	73 — 75	73 — 75	74½	..	..	5 6 8
544,216	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	92 — 94	92 — 94	95⅜	..	..	4 5 1
544,216	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	53 — 56	53 — 56	54	..	..	7 2 10
1,480,000	City and South London Railway	Stock	2⅜%	2⅜%	1½%	2½%	49 — 51	47 — 49	50½	47⅜	—2	4 6 9
85,000	Crompton & Co., Nos. 1 to 85,000	3	2½%	2½%	2½%	5 %	1⅜— 2⅛	1⅛— 2⅛	43/9	41/3	+ ⅛	6 17 11
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	93½— 96½ xd	93½— 96½	..	..	..	5 3 8

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations July 16th.	Closing Quotations July 23rd.	Business done week ended July 23rd, 1907.		Rise + or Fall —	Present Yield per cent.
		*	1903.	1904.	1905.	1906.			Highest	Lowest.		£ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	10 %	10 %	..	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	6 3 1
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	..	1 — 1¼	1 — 1¼	..	..	..	4 16 0
294,150	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	100 —103 xd	100 —103	..	..	..	4 7 5
60,000	Dublin United Trams. (1896), 1 to 60,000	10	5½%	6 %	6%	6 %	13¾— 14¼	13¾— 14⅛	..	..	..	4 2 9
59,987	Do. 6 % Pref. between 1 and 60,000	10	6 %	6 %	6 %	6 %	13 — 14	13 — 14	..	..	..	4 9 8
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	N	2½%	4½%	..	1¾ — 1⅞	1¾ — 1⅞	..	..	..	9 1 10
17,139	Do. "A" shares, 01—017,139	5	N	2½%	4½%	..	2⅛ — 2⅜	2⅛ — 2⅜	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	83 — 85 xd	83 — 85 xd	..	..	..	4 14 2
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	89 — 92	89 — 92	..	..	..	5 8 8
112,100	Electric Contruction, 1 to 112,100	2	4 %	Nil	Nil	..	⅜ — ⅞	⅜ — ⅞	..	..	..	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	..	1⅛ — 1⅜	1⅛ — 1⅜	..	..	— ¼	10 3 9
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	4 %	5 %	5 %	5 %	8 — 8¼	8 — 8⅛	..	..	..	5 17 8
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	92 — 95	92 — 95	..	..	..	5 14 3
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	3 %	4 %	4 %	4 %	2 — 2¼	2 — 2¼	..	..	..	20 0 0
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10½ — 10¾	10½ — 10¾	..	..	..	6 13 4
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	1 02 —103	102 —103	..	..	..	4 17 1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15%	15 %	11½ — 12¼	11½ — 12⅜	12	..	..	6 0 0
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 — 5¼	5 — 5⅛	..	..	..	3 17 3
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	105¼—107¼	105½—107⅝	105⅓	..	..	4 3 9
50,000	India-Rubber, Gutta-percha & Telegraph Works.	10	10%	5 %	10%	10 %	15 — 16	15 — 16	..	..	..	6 5 0
37,500	†Liverpool Overhead Railway, Ord.	10	1⅜%	1½%	Nil	Nil	1¼ — 1⅜	1¼ — 1⅜	..	..	..	Nil
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	5 %	6¼ — 7⅛	6¼ — 7⅛	..	..	..	6 13 4
600,070	London United Trams. (1901), 1 to 50,007	10	8 %	6 %	3 %	3 %	6¼ — 7⅛	6¼ — 7⅛	..	..	..	3 8 7
399,930	Do. do. 60,008 to 100,000	10	8 %	6 %	3 %	3 %	6¼ — 7⅛	6¼ — 7⅛	..	..	..	5 2 2
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	7⅜ — 8⅜xd	7⅜ — 8⅜	8 7/16	8 1/16	..	5 14 3
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	84 — 88	84 — 88	..	..	..	4 10 11
314,016	Metropolitan Electric Trams., Defd.	1	Nil	Nil	Nil	Nil	3/16 — 5/16	3/16 — 5/16	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	31/32 — 1 1/32	31/32 — 1 1/32	..	..	..	4 12 9
350,000	Do. do. 4½ % Deb. Stock Red.	100	..	4½%	4½%	4½%	94 — 97 xd	94 — 97	..	..	..	4 10 11
30,000	Peebles (B.) & Co., 6 % Cum. Pref., 20,001 to 50,000	5	..	6 %	6 %	6 %	3⅞ — 4⅛	3⅞ — 4⅛	..	..	..	7 2 3
245,500	Potteries E. Tre.	1	5 %	5 %	4 %	4 %	1/16 — 3/16	1/16 — 3/16	..	..	..	6 8 0
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/16 — 3/16	1/16 — 3/16	12/6	10/-	+ 1/16	7 5 5
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
37,350	Telegraph Construction and Maintenance	12	20 %	15 %	15 %	15 %	31 — 33	31 — 33	31½	..	..	5 9 1
150,000£	Do. 4 % Ded. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	99 —102 xd	99 —102	..	..	..	3 18 5
592,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	5 %	5 %	5 %	64 — 67	64 — t7	..	..	..	7 9 3
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	3 %	Nil	Nil	..	1½ — 1⅔	1½ — 1⅔	..	..	..	Nil
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	Nil	Nil	..	3½ — 4	3½ — 4	70/7½	..	+ ½	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	77 — 81	76 — 80	..	..	—1	5 0 0

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P,. 1 to 14,000	5	5 %	5⅓%	5⅓%	5⅓%	4⅞— 5⅛	4⅞— 5⅛	..	..	..	5 4 9
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	98 —100	98 —100	..	..	..	4 10 0
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	10%	7⅞— 8⅜	7⅞— 8⅜	..	..	..	6 1 3
10,202	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7¼— 8⅛	7¼— 8⅛	..	..	..	4 2 4
336,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply	5	8 %	8 %	5 %	5 %	3¾— 4	3¾— 4	..	..	..	6 5 0
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4 — 4¼	4 — 4¼	80/-	..	..	5 0 0
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅝ — 4	3¾ — 4	..	..	— ⅛	5 12 6
427,400	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	95 — 98	95 — 98	..	..	..	4 1 8
49,436	Chelsea Electricity Supply, Ord.	5	5⅓%	6 %	6 %	4½%	3⅝ — 4¼	3¾ — 4¼	..	..	..	5 0 0
175,000£	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	102 —105	101 —104	..	..	..	4 5 9
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	6 %	6 %	6 %	9 — 10 xd	9 — 10	..	..	..	6 0 0
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11 — 12	10⅝— 11⅝	..	..	— ⅛	5 2 2
400,000£	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	120⅜—123½	121 —124	..	..	+ ½	4 0 8
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	95 — 98	96 — 99	98	96⅛	+1	4 10 11
40,000	County of Durham Electrical Power, Ord.	5	4 %	£3 7 0	4 %	4 %	4¼ — 5	4⅜ — 5	..	..	..	4 0 0
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	4½ — 5	4⅜ — 5	..	..	..	5 0 0
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4½%	5 %	5 %	7 — 8	7 — 8	7⅛	..	..	6 5 0
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10¾— 11⅛	10⅝— 11⅛	11 3/16	..	..	5 4 4
400,000£	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	106 —109	106 —109	..	..	..	4 2 7
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	93 — 96	94 — 97	95	94	+1	4 12 9
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	4 %	Nil	⅛ — 1	⅛ — 1	10/-	..	..	11 0 0
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	3 %	1 — 2	1 — 2	51/3	..	..	15 0 0
350,000	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	76 — 81 xd	76 — 81	..	..	..	5 11 1
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅞— 5⅜	4⅞— 5⅜	..	..	..	5 8 5
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 16 8
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
13,000	Hove, 1 to 13,000	5	8½%	8½%	9 %	9 %	6⅞— 7⅛	6⅞— 7⅛	..	..	..	6 4 2
21,000	Kensington and Knightsbridge Electric Ord.	5	12½	12 %	10 %	10 %	8⅝— 9⅛	8⅝— 9⅛	..	..	..	5 0 0
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..	4 5 1
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	3 %	4 %	4 %	1⅜ — 2⅛	1⅜ — 1⅛	..	..	..	5 12 3
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	5 17 1
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4½%	98 — 98	93 — 96	93½	93	..	4 18 9
200,000	Metropolitan Electric Supply, 1 to 100,000	5	83%	10 %	10 %	8 %	5⅞ — 6⅜	5⅞ — 6⅜	6⅛	6 1/32	..	5 14 3
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅜ — 5⅛	4⅜ — 5⅛	5 3/32	..	..	4 5 9
220,000£	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	103 —107	103 —107	..	..	..	4 4 1
250,000£	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	86 — p1	87 — f2	..	..	+1	3 16 1
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	95 — 18	95 — 98	..	..	..	4 11 10
67,991	Newcastle-on-Tyne	5	8 %	8 %	8 %	8 %	7⅛ — 7⅞	7⅛ — 7⅞	..	..	..	5 8 3
75,000	Do. 5 % Pref., 1 to 75,000	5	5 %	5 %	5 %	5 %	5 — 6	5 — 6	..	..	..	4 3 4
10,852	Notting Hill Electric Lighting	10	6 %	7 %	7½%	7½%	11⅜ — 12¼	11⅜ — 12¼	..	..	..	6 0 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	6½%	7 %	7 %	7 %	5¾ — 6⅜	5¾ — 6⅜	..	..	..	5 9 11
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	15 — 97	95 — 97	..	..	..	4 2 6
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	12½%	10 %	8 — 9	8 — 9	..	..	..	5 11 1
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6¾ — 7⅛	6¾ — 7⅛	..	..	..	4 13 4
150,000£	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3 %	3½%	86 — 91	86 — 91	..	..	..	3 16 11
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	Nil	⅛ — 1¼	⅛ — 1⅛	..	..	..	Nil
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	78 — 77	73 — 77	..	..	..	5 3 11
65,000	South London Electricity Supply, Ord.	5	3 %	4 %	4 %	3 %	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	6 13 4
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	2½%	2½%	⅝ — ¾	⅝ — ¾	..	..	..	3 6 8
117,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1¼ — 1⅜	1¼ — 1⅜	..	..	..	5 1 10
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	11 2 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	2 — 3	2 — 3	..	..	..	8 6 8
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	..	4½%	4½%	4½%	94 — 97	94 — 97	..	..	..	4 12 9
110,000	Westminster Electric Supply, Ord.	5	13⅓%	14 %	13 %	12 %	9 — 10	9 — 10	9⅛	9⅛	..	6 0 0
81,279	Do. do. 4½ % Cum. Pref. (Original 5 %—Red. to 4½ % from 31st Dec., 1905)	5	5 %	5 %	5 %	4½%	5⅛ — 5⅜	5 — 5⅛	5 1/16	..	— ⅛	4 1 10

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 4 per cent., April 25th, 1907.

THE ELECTROSTATIC CAPACITY BETWEEN A VERTICAL METALLIC CYLINDER AND THE GROUND.*

BY A. E. KENNELLY AND S. E. WHITING.

IT is well-known that every problem of the electrostatic capacity of a condenser formed by any pair of conducting surfaces, and separated by a uniform insulating medium, is equivalent to a corresponding problem of the electric conductance between the same, similarly placed, pair of surfaces, separated by a uniform conducting medium. The solution of either of such a pair of problems immediately leads to the solution of the other.

If, therefore, we desire to predetermine the capacity of a pair of conductors in definite geometrical relation, when the computation cannot be effected by ordinary rules, we may construct a model of the geometrical system, either on the same dimensional scale as the original, or upon a conveniently reduced scale, substitute a uniform conducting solution for the dielectric, and measure the conductance between the conductors as electrodes. This conductance will correspond to, and determine, the capacity of the original system considered.

As an example, we may consider the familiarly simple case of a condenser formed by two opposed parallel metallic disks of diameter very large compared with the distance between them. If the surface of each disk be s sq. cm. and the distance between them be l cm., the well-known formula for the capacity of the system, ignoring the irregularity at and beyond the edge of the disks, is:—

$$C = \frac{\kappa}{4\pi} \cdot \frac{s}{l} \text{ centimetres or abstatfarads,} \qquad (1)$$

where κ is the specific inductive capacity, or inductivity, of the medium, and C is the capacity in absolute electrostatic units, which may be abbreviated into "abstatfarads."

The conductance offered between the same similarly situated disks, separated by a conducting medium of conductivity γ mhos per centimetre, is well known to be

$$g = \gamma \cdot \frac{s}{l} \text{ mhos,} \qquad (2)$$

where γ is numerically equal to the conductance of a centimetre cube of the medium between any pair of parallel faces, or

$$\gamma = \frac{1}{\rho} \text{ mhos per centimetre,} \qquad (3)$$

where ρ is the resistivity of the medium in ohm-centimetres, and is numerically equal to the resistance of a centimetre cube of the material between any pair of parallel faces, expressed in ohms.

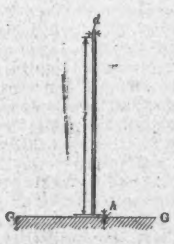


FIG. 1.

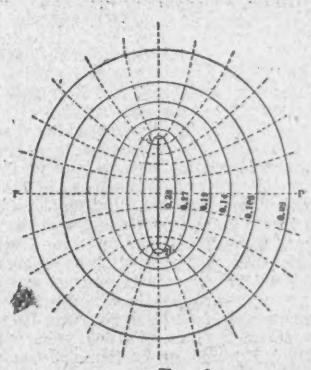


FIG. 2.

The capacity in abstatfarads, or centimetres, of the dielectrically-separated system is, therefore, related to the conductance in mhos of the conductively-separated system by the formula:

$$C = \frac{\kappa}{4\pi\gamma} \cdot g = \frac{\kappa\rho}{4\pi} \cdot g \text{ abstatfarads.} \qquad (4)$$

This formula is quite general in application, and is not limited to the particular case of plane parallel disks above considered. The two conductors may have any form and relative disposition. If g is expressed in abmhos, γ must be expressed in abmhos per centimetre and ρ in absohm-centimetres.

If the pair of conductors on which the measurement of conductance is made, be a perfect model of the condenser n times reduced in linear scale, so that every centimetre in the actual condenser is represented by 1/nth of a centimetre in the conductance model, then we know that the conductance of the model will thus be reduced n times below the value that would be obtained with a system of full size. Consequently, if g' be the observed conductance of the small model, the value of g to use in formula (4) will be

$$g = n\,g' \text{ mhos.} \qquad (5)$$

If the capacity of a system of conductors is capable of being readily computed by known formulas, it is unnecessary to resort to a conductance measurement. If, however, the geometrical system of the condenser is too complex to permit of a computation being made, it may be convenient to avoid constructing the actual condenser, and to construct in its place a small scale conductance model, for use in connection with formula (4). The capacity may then be reduced to its value, C_{abf}, in "abfarads," or absolute electromagnetic units, by the relation—

$$C_{abf} = \frac{C}{v^2} = \frac{C}{9 \times 10^{20}} \text{ abfarads,} \qquad (6)$$

where v is the speed of electromagnetic waves in free ether (3×10^{10} cm. per second). In farads,

$$C_f = C_{abf} \times 10^9 = \frac{C}{9 \times 10^{11}} \text{ farads} \qquad (7)$$

The capacity of a condenser formed by a long conducting cylinder, supported perpendicular to, and not far away from, an indefinitely extended horizontal plane surface, does not seem

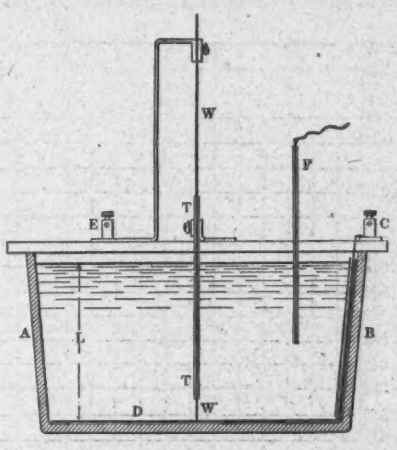


FIG. 3.—SECTIONAL ELEVATION OF THE CONDUCTANCE-MODEL.

to have been worked out mathematically. This case is of practical interest, since it corresponds substantially to that of a cylindrical vertical antenna, or aerial, in wireless telegraphy. The geometrical conditions are indicated in fig. 1. A conducting cylinder of radius r cm., or diameter d cm. and length l cm. is insulated from the level conducting surface of the ground G G by a vertical distance h cm. The length l is large with respect to h and d.

It is known that the capacity of a long straight cylinder of length l cm. and radius r cm. in free space, remote from other conductors, may be computed as the limiting case of an ellipsoid of revolution by the formula:

$$C = \frac{l}{2\log_e \frac{l}{r}} \text{ abstatfarads.} \qquad (8)$$

This is the formula frequently used for estimating to a first approximation the capacity of a cylindrical vertical in wireless telegraphy, of the type indicated in fig. 1. The distributions of electric flux and potential around such a limiting ellipsoid, remote from other conductors, are represented in fig. 2, where A B is the thin vertical cylinder, with a length of 100 diameters. The equi-potential surfaces are confocal ellipsoids of revolution, and are confocal ellipses in section, as shown. Their successive potentials are 38, 27, 19, 14, 10·5 and 8 per cent. of the potential of the axial ellipsoid, or vertical wire. The dotted lines represent electric flux paths and are confocal hyperbolas. It is evident that the flux is directed equally above and below the plane P P.

On the other hand, if we bring the wire A B close to the ground, as indicated in fig. 1, the distributions of flux and potential become disturbed. The flux becomes denser in the lower portion of the system near to the ground, and the equi-potential surfaces are squeezed together underneath the wire.

It seemed desirable to ascertain experimentally how far the capacity is increased above the value given by formula (8) when different lengths of insulated vertical cylinder are employed at short distances above the ground. Instead of attempting to make these measurements of capacity on a reasonably large scale, with cylindrical conductors out of doors, a small-scale conductance model was used in the laboratory, with copper electrodes immersed in a large tub containing dilute copper sulphate solution. The arrangement of the model is represented to scale in fig. 3. A B is a tub of fibrous insulating material. At the bottom was placed a disk D, of copper, 54·2 cm. in diameter and 1·59 mm. thick, connected by an insulated wire to a terminal C. A vertical copper wire W W, connected to terminal E, rested on the centre of the copper disk, being insulated from the same by a small flake of mica. A glass tube T T, fitting fairly closely to the wire W W, could be moved up and down or clamped at any position, so as to expose any desired length of the wire W W to the solution which filled the tub up to the level L.

The specific gravity of the copper sulphate solution was 1·03 at 10° C., and the measurements were made at temperatures near to 10° C. The resistance between the vertical wire W W and the disk D was measured by Wheatstone bridge, using the terminals C E. Readings were taken to "false zero," or polarisation-current zero

* From the *Electrical World and Engineer* (slightly abbreviated).

on the galvanometer scale, so as to minimise the disturbing influence of polarisation E.M.F. on the observations. The measurements were made with two vertical wires in succession. The first had a diameter of 2·5 mm. and the second a diameter of 0·965 mm. The results are given in the curves of fig. 4, in which the abscissas represent the lengths of the exposed vertical wire, and the ordinates the observed conductances, or the reciprocals of the resistances observed by Wheatstone bridge, after correcting for leads. Thus, with 13 cm. of the 2·5-mm. wire exposed, the conductance observed was 0·20 mho.

In order to bring the two series of observations of fig. 4 into comparative relation, each is referred for convenience to an enlarged model supposed to have a cylinder diameter of 100 cm. The values given in fig. 4 are referred to this particular assumed size of model by the formula (5). The results appear in fig. 5, where the circles represent conductances derived from the 2·5-mm. wire, and the crosses represent conductances derived from the 1-mm. wire. The two sets of conductances are seen to be in fair agreement, and the curve is

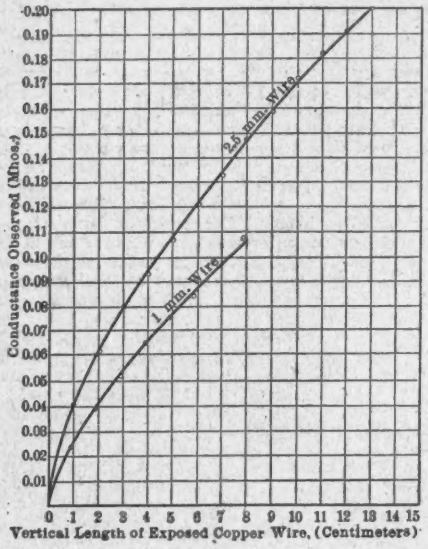


FIG. 4.—CONDUCTANCES OBSERVED WITH DIFFERENT LENGTHS OF VERTICAL WIRE EXPOSED.

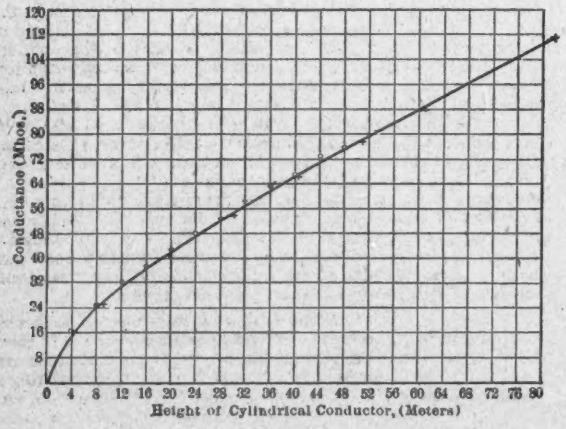


FIG. 5.—CONDUCTANCES REFERRED TO A CYLINDER 1 METRE IN DIAMETER.

intended to represent them jointly. Thus a vertical cylindrical conductor 80 metres in height and 100 cm. in diameter, insulated from a correspondingly enlarged horizontal disk, and deeply immersed in the same copper sulphate solution, would offer a conductance of 108·8 mhos.

(To be continued.)

ELECTRICAL ACCIDENTS DURING 1906.

As mentioned last week the annual report of the Chief Inspector of Factories and Workshops for the year 1906 has been published, and, as usual, it contains an interesting and exhaustive report by Mr. G. Scott Ram, H.M. Electrical Inspector of Factories. It appears that, in electricity supply stations, there were 208 non-electrical accidents, eight having fatal results, and 37 electrical accidents, of which two were fatal.

The electrical accidents reported show only a very slight increase over those of the previous year. In regard to Class 2, cleaning or repairing "live" switchboards, which includes one fatality and 13 non-fatal accidents, it is often open to doubt whether the work could not have been done at a time when the pressure might have been cut off. In the fatal case, the man was repairing switchgear, close to other "live" and unprotected switchgear, against which he stumbled; the pressure was 10,000 volts. Two accidents from short-circuit occurred to persons when taking measurements of "live" switchboards with metal rules. Another befell a man when making a sketch of a sub-station, by coming into contact with a "live" switch at 10,000 volts pressure.

Electrical accidents at private electrical generating stations numbered 14, five occurring at switchboards to men engaged in ordinary routine work (mostly due to faulty design of apparatus), and four to men who were cleaning, repairing, &c., at "live" switchboards.

Electrical Accidents in Factories.

The following is a list of reported electrical accidents in factories, engineering works, &c.:—

	Non-fatal.	Fatal.
(1) (*a*) Arcing of switches	28	—
(*b*) Arcing of fuses	10	—
(2) Arcing at fuses, when replacing fuse wires	14	—
(3) Unprotected conductors, switches, terminals, fuses, &c.	11	1
(4) Faulty apparatus (other than switches)	37	2
(5) Working on live conductors:—		
(*a*) Skilled persons	19	1
(*b*) Unskilled persons	5	—
(6) Flashing at motor brushes when adjusting	9	—
(7) Electric travelling cranes:—		
(*a*) Unprotected electrical apparatus in driving cage	3	—
(*b*) Faulty apparatus	3	—
(*c*) Carelessness	9	—
(8) Miscellaneous accidents in testing electrical apparatus in course of manufacture	22	1
(9) Miscellaneous	21	3
Total	191	8

In this list there is a considerable increase over those of the previous year, the number having risen from 122 to 199, or over 60 per cent., including eight fatalities against four in the previous year. "The increase is scarcely to be wondered at in view of the greatly extended use of electricity, and to the fact that the necessity of proper precautions being taken is often not realised by the occupier, who accepts the lowest tender for his installation without being aware that the price is low because the apparatus is inferior and often without elementary safeguards. There is little, if anything, new in the nature of the accidents."

"Thoughtlessness or Neglect."

Writing again this year on various dangerous conditions of electrical plant which he has come across, Mr. Ram says: "Whilst in some cases they are excused on account of being merely the survival of old installations, perhaps considered good at the date of their erection, in others, the plant being of quite recent date, there can be no excuse on the score of antiquity, and there would appear to be none on any other grounds than those of thoughtlessness or neglect. Perhaps the most striking example is one which I found in an important generating station for public supply in regard to a switchboard for three-phase working at 6,000 volts pressure, which had recently been erected and put to work. This switchboard was apparently satisfactory so far as the working platform was concerned, but the various passage-ways in connection with it were a series of death-traps. One long passage had on one side rubber-covered cables at 6,000 volts without any protection by metallic sheathing or casing, and on the other, exposed live terminals at the same pressure at frequent intervals. The floor of the passage was of iron and 2 ft. 4 in. wide. The bus-bar galleries were even less inviting. In one of these there was on one side of the passage-way sheet metal for protecting glass water resistances, used in connection with the spark-gaps. On the other side at about 1 ft., 2 ft. and 3 ft. from the floor, respectively, were the three bare and unprotected bus-bars at 6,000 volts. The floor of this passage-way was of iron and the clear width was about 18 in. In another the passage-way was a little wider on account of the absence of spark-gap resistances, and the edge of the iron flooring was fenced with an iron railing; there was, therefore, a passage-way about 2 ft. wide with the bare 6,000-volt bus-bars on one side and the iron railing on the other. One would naturally suppose that such passages were never intended for use when the bus-bars should be alive, but such restriction did not appear to have been contemplated, as half-way along the gallery the bus-bars were divided by means of plug switches, with the idea that the two halves of the board might be run together or from independent generators. No means of access was, however, provided for getting to these plug switches other than along the passage-way described. Even assuming that the attendant should safely reach the plug switches there was no room for him to work them, the iron railing being less than 2 ft. away. These plug switches were heavy, and would necessarily have to work stiffly in the contacts in order to make a good connection, and would, therefore, require a strong effort to work them. There was exposed live metal within 3 or 4 in. of the handles, and the bus-bars were, of course, close to; the combined arrangement being such as to offer a great and totally unwarrantable risk in operation. The safeguards, usually present in switch-

boards for extra high-pressure systems of this kind, for preventing danger of accidental contact with live metal, were conspicuous by their absence, whilst the narrowness of the passage-ways and the provision of earthed metal to stand on provided all that could be wanting to contribute to a maximum degree of danger. Other new switchboards in connection with the same undertaking exhibited a like disregard for safety." It is difficult to account for apparently reckless want of thought in cases such as this, where the danger is so obvious and of such serious kind, *i.e.*, sudden death to the unwary attendant, particularly in view of the importance of the undertaking and the high standing of the makers of the apparatus.

Want of Foresight.

The risk of personal accident is closely associated with that of breakdown of the supply, and it is often a matter of surprise that it is not more carefully guarded against as a pure matter of business. Want of foresight is frequently apparent in the arrangement of switchboards; thus, again, at the new generating station of an electrical power supply company, furnishing electrical energy for working tramways and for power purposes in collieries and for general supply in several townships—a class of supply which must necessarily be maintained night and day—the main high pressure switchboard was so designed that it could not be made dead for adjustment or repairs in sections; consequently in order to carry out any work upon it in safety, the whole supply would have to be shut down. In practice it would probably not be shut down, and any repairs or other work would be carried out at a considerable risk to the workers—a risk which could have been entirely obviated by a proper design of switchboard in the first instance.

Points Overlooked in New Stations.

"I noticed various other points of greater or less importance which had been over-looked in new stations. For example, in a generating station of a local authority for providing continuous current at 440 volts, the switchboard was placed so that it might have had plenty of clear space behind, but the advantage was entirely lost on account of rods and cables being fixed across so as to completely block the passage-way. In another case of new work in a large station, a glass-tiled floor had been laid behind the switchboard. The glass floor was only 20 in. wide, and at the sides the iron framework projected an inch above the glass, thereby nullifying to a great extent the safety, as regards insulation, provided by the glass."

Dangers in Sub-stations.

In sub-stations, both new and old, Mr. Ram found many cases where safety had been insufficiently provided for, and some where the means intended to procure safety added considerably to the dangers. In some colliery sub-stations, where it was important that the supply should be available continuously, the high-pressure switchboards were arranged so that it would be impossible, without great danger, to carry out any repair or adjustment unless by completely shutting down the supply. In two cases he found that the consumers' medium pressure switchboards were within the sub-stations, regardless of the Board of Trade regulation that the sub-stations should be in the sole occupation of the supply authority. These sub-stations were supplied at 10,000 volts pressure, three-phase. The 10,000-volt conductors were of bare copper. The transformers and high-pressure switchgear were on one side of the room and the consumers' switchboard on the other, with only a few feet of space between them. The arrangement of exposed high-tension conductors was dangerous in any case, and particularly so in view of the consumers' employés having access. "I made strong representations as to the dangers and as to the breach of the Board of Trade regulations, and it was agreed that the power company's men should alone have access until suitable screens had been erected to entirely shut off all the high-pressure side of the room. The consumer, however, employed an electrical engineer, who, perhaps, did not agree with my view of the danger, at any rate, as applying to himself, and contrary to the instructions of his employers, he, a few days later, went into one of the sub-stations and walked against a 10,000-volt conductor. That he was not killed was due to the fact that the current did not pass through a vital part of his body, but he was very severely burned about the legs. Subsequent inquiries showed that this man had been previously employed in a high-tension generating station, and should therefore have been fully aware of the dangers. This fact merely emphasises the necessity of proper protection being provided equally, whether skilled or unskilled persons have access."

In some less recent transforming sub-stations, Mr. Ram found a form of protection provided for the high-pressure switchgear, which distinctly added to the danger. The switches and bus-bars were of bare metal exposed, but the whole switchboard was surrounded by an iron cage with a door. When any switching or replacing of fuses became necessary, the attendant would therefore have to go into the cage, which was so confined that he would inevitably be in contact with its iron bars, thereby being in contact with earth, and would besides have insufficient room to work in. In some other underground chambers, far too small, he found some survivals of a bygone age in the form of protection of the high-pressure terminals of the cables by metal covers or bells. The terminals were bare, and in order to get at them for any purpose, the bell, which was heavy, had to be lifted vertically with a very steady hand, or it would touch the terminals. An earth wire was attached to the bell, but in one case this wire proved to be very much alive!

In motor-generator sub-stations the inspector found numerous cases of the high or extra-high pressure coils of the motors being insufficiently protected. Adequate fencing of these machines is seldom provided. Accidents have occurred through men putting out their hands to steady themselves and touching the high-pressure stator coils when examining the lubrication of the bearings. In some continuous-current sub-stations the motor converters are placed with a passage-way between them of less than 20 in. and having their exposed high-pressure terminals sticking out into the passage-way on each side.

The practice as to employment of persons in sub-stations is one which varies considerably. In large sub-stations having moving machinery it is customary for at least two persons to be employed simultaneously. There are, however, examples where from motives of economy only one person is employed at a time. Thus, in two large sub-stations Mr. Ram found one man employed alone in each. The incoming supply was three-phase at 6,000 volts. The one man had to attend to the working of the plant, consisting of two motor-generators, one for traction and one for general supply, and three switchboards for the high-pressure, traction, and general supply with a secondary battery. The starting up of the motor-generators was accomplished by barring them round with a plank. The question is whether, in view of the nature of the work and its attendant dangers, one man should be left entirely alone.

Exposed Switches and Terminals.

On factory premises, says Mr. Ram, "I found the usual examples of exposed switches, terminals, &c., in dangerous positions; that is to say, in places where a person who might accidentally touch the live metal would be in connection with earth, either by standing on damp ground or iron floor-plates or otherwise, and would consequently obtain a severe shock. One particularly dangerous type of switch appears to be a universal favourite. It has two or more blades, hinged at one end, and held together at the other by a bar of insulating material, on the other side of which is the handle. The insulating bar is attached to the switch blades by studs or screws having heads or nuts on the handle side, and generally close to the handle. In the better makes of these switches these nuts or studs are covered by insulating caps, or are sunk in the bar and covered over with insulating material, but usually they project above the bar in such a way as to be naturally in contact with the hand of a person grasping the handle. The connections of the switch are variously arranged. In some the blades of the switches are only alive when the switches are in the "on" position, in others the connection is through the hinged ends and the blades are always alive. The studs are therefore always alive when the switch is "on," and in some cases also when it is "off." The danger is obvious. When the studs are close to the handle, as is frequently the case, a person may touch both studs with his hand when working the switch. The switches are often used as motor switches with 440 or 500 volts across the studs, with the result that the operator is likely to get severely burned. When, as is often the case, such a switch is fixed over a damp floor or over iron floor plating, there is the additional danger of a serious shock to earth. In a previous report I described a fatal case of shock due to such a cause. The current was alternating, 250 volts. The victim was going to stop a motor. He touched one of the studs with his little finger in grasping the handle of the switch, and although the latter was of insulating material, he could not release his hold or pull the switch "off," and was killed. I refer to this accident again, as the particular type of switch is being constantly supplied. I found them in new installations in factories, on cranes in docks, in electrical stations, &c., in dangerous positions. I also found them in use as high-pressure switches in sub-stations, 2,000 volts across the studs, and placed in dangerous situations where the person using them would be in contact with an earthed transformer case. A more dangerous trap could hardly be devised."

Questions as to guarding overhead transmission wires occurred in connection with a large private installation. The supply was by a three-phase system at 3,300 volts. The wires ran alongside and over roadways and footpaths and places where people were working. Some system of protection against falling wires seems necessary at such points, but none had been provided.

Dangers of Low Pressures.

"All the fatal accidents reported as having occurred on factory premises were due to shock from alternating current, at various pressures down to 200 volts, no less than four occurring at the latter pressure. It is customary when fatalities occur at such low pressures for people to say that the victims must have had weak hearts. This view, however, is seldom confirmed, the post-mortem examination often proving the contrary. The danger with low pressures depends upon the path of the current through the body and the kind of contact. People who are responsible for electrical installations do not sufficiently realise the hidden dangers of low-pressure currents, and hence the weak heart theory is brought out at every inquest, but until recently I had never heard of it being seriously put forward to account for a fatality where the pressure exceeded 5,000 volts."

Accidents not Reported.

"I have reason to think that a number of accidents from shock do not get reported. I happened to come across a man recently who owned to having been in hospital for several weeks as the result of a shock received whilst working on a 10,000-volt switchboard. The accident had not been reported. It occurred in an electrical power company's generating station, but the man was working for a contractor. Possibly the contractor assumed that the power company would report it and *vice versâ*. The question of the responsibility for the safety of contractors' workmen when working in an electrical station I have referred to in a previous report. It is certain that the contractor's workman is often required to do work of a hazardous nature without adequate supervision. It is probable that under the new Notice of Accidents Act many more electrical accidents will be in future reported, but at present the provisions of this Act seem to be very little known."

Shock Fatalities Tabulated.

The following is a list of electrical fatalities occurring during the year, including those not reportable under the Factory Act, so far as Mr. Ram has been able to ascertain them:—

Electrical Fatalities in 1906.

Date.	Place.	Voltage of system.	Probable voltage of shock.	System.
	Reported under the Factory Act.			
April	Wednesbury	350	200	Alter. 3-phase
May	Belvedere	8,000	8,000	Alter. 1-phase
June	Blaina	440	250	Alter. 3-phase
July	Wednesbury	5,000	3,000	Alter. 3-phase
July	Leeds	230	200	Alter. 2-phase
Sept.	Brimsdown	11,000	6,500	Alter. 3-phase
Sept.	Derby	200	200	Alter. 1-phase
Nov.	Ramsbottom	400	230	Alter. 3-phase
Dec.	Scotstoun	350	200	Alter. 3-phase
Dec.	Burnbank	11,000	6,500	Alter. 3-phase
	On Mains of Electrical Supply Undertakings. (Reportable to Board of Trade.)			
July	Near Glasgow ...	10,000	—	3-phase
	Mining. (Reportable to H.M. Inspectors of Mines. Probably incomplete.)			
Jan.	Lower Duffryn Coll.	3,300	—	Alter. 3-phase
Jan.	Cadeby Colliery ...	500	—	(?)
May	Emily Mine	—	—	(?)
July	Cwmneol Colliery ...	3,000	—	Alter. 3-phase
July	Cwmneol Colliery ...	3,000	—	Alter. 3-phase
Aug.	Dean & Chapter Coll.	500	—	(?)
	Railways and Tramways. (Reportable to Board of Trade.)			
March	London—Notting Hill Gate (Central London Railway)	5,000	—	Alternating
March	Heywood	500	—	Continuous
July	East Ham—Metropolitan District Railway	600	—	Continuous
Aug.	Byker—North-Eastern Railway	600	—	Continuous
Sept.	London—Mansion House Station, District Railway	600	—	Continuous
Sept.	Darlington	500	—	Continuous

THE CLARK PORTABLE WIRELESS TELEGRAPH SET.

By A. FREDERICK COLLINS.

The Signal Corps of the United States Army has been using for some time past a new type of portable wireless apparatus, designed by Mr. Thomas E. Clark, of the Clark Electrical Engineering Co., of Detroit, Michigan, and the following data will serve to indicate the weights and dimensions permissible for this exacting class of work.

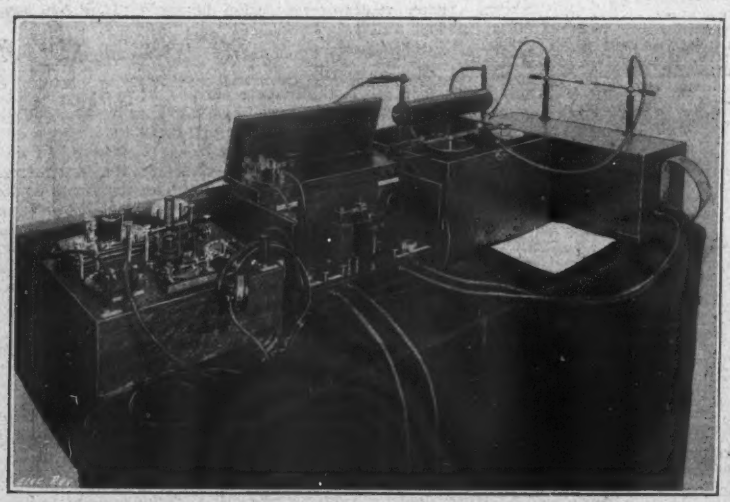


Fig. 1.—General Arrangement of the Apparatus.

Differing from the military installations furnished by the Gesellschaft für Drahtlose Telegraphie, of Berlin, to the German and Russian Armies, wherein the transmitters and receivers are mounted on carriages, the Clark portable equipments are intended to be conveyed on the backs of mules if vehicles are not available, while the individual units are sufficiently small to be carried by hand if circumstances require it.

The portable sets are made up of four units, the storage battery and the aerials. The transmitter and the receiver are enclosed in oak cases with strong shoulder straps attached for carrying. The first transmitter unit contains the induction coil, and the outside dimensions of the case measure 8½ in. in height, 21 in. in length, and 8½ in. in width, while the weight is 60 lb. The second transmitting unit includes a Morse key, interrupter, and other appliances; the case containing these is so arranged on hinges that when it is unlocked it may be folded back, and ready access to the different parts may be had. This unit has a height of 8 in., a length of 16 in., and a width of 9½ in., the weight being about 30 lb.

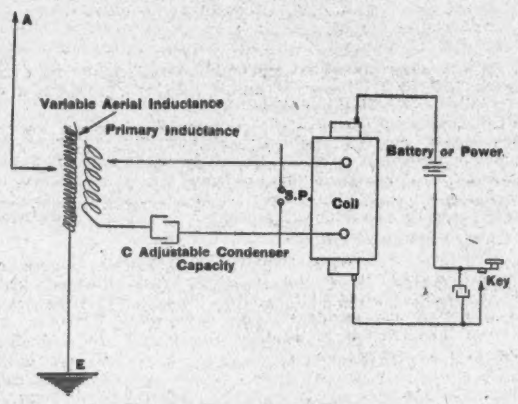


Fig. 2.—Transmitter Circuits.

The third transmitting unit comprises a battery of from two to four half-gallon Leyden jars mounted carefully in an oak case, and this also contains a step-up transformer and an induction coil with aerial switch and ground plug connections. Placed in the top part of this case is a shelf arrangement, so that, when the apparatus is used, the shelf supports the rear part of the case, permitting it to be turned upright and forming a base for the hard rubber columns on which the transformer and induction coils rest. The height of this case is 15½ in.; length, 20½ in.; width, 7¾ in.; and its weight is 20 lb.

The receiver consists of a unit having an outer and an inner case; the former is made of a special waterproof canvas provided with a heavy leather handle and straps, catches, lock and key. The inner case is of quartered oak, the instruments of the receiver being mounted thereon. The dimensions of this unit are: height 10 in., length 14 in., width 20 in., and its weight is 20 lb. The four units are easily carried by two men, thus conforming to the specified requirements of the United States Signal Corps for field work, during manœuvres, for vessels when repairing cables, and for fire and control signals in target practice. Fig. 1 shows the apparatus assembled ready for use, and figs. 2 and 3 show the connections.

The transmitter is divided into two parts, one containing the induction coil and the other the subsidiary apparatus, such as the interrupter, key, &c. Flexible conductors, with brass plug-ends, are provided for making the connections, and this is done by inserting the plugs in the spring-jacks at the end of the coil case and the condenser case marked "*coil*." The leads from the batteries are connected to the binding posts on the condenser case designated "*line*." Anyone, however inexperienced, can make these connections, since all that is necessary is to make good contacts.

The spark-gap and rods on the coil case are easily slipped into their respective hard-rubber supporting pillars, and when pushed home make firm contact with the terminals of the secondary beneath. There are two sets or pairs of iridio-platinum contacts on the interrupter; the small contacts make and break the circuit supplied to the magnet coil, and cause the armature to vibrate entirely independently of the current supplied to the primary coil, while the large contacts interrupt the current supplied to the primary coil.

The condenser switch is placed in the upper right-hand corner of the condenser case, and is employed to regulate the capacity bridged across the large contacts of the interrupter. The condenser is of the adjustable type, so that it can be varied in accordance with the amount of current used. The pole-changing switch is in the upper left-hand corner of this case, and is used to change the direction of the current across the spark-gap of the coil, if so desired. The operating switch is below the pole-changing switchboard, and is used to turn the current on and off the primary coil, independently of the Morse key. The interrupter switch is

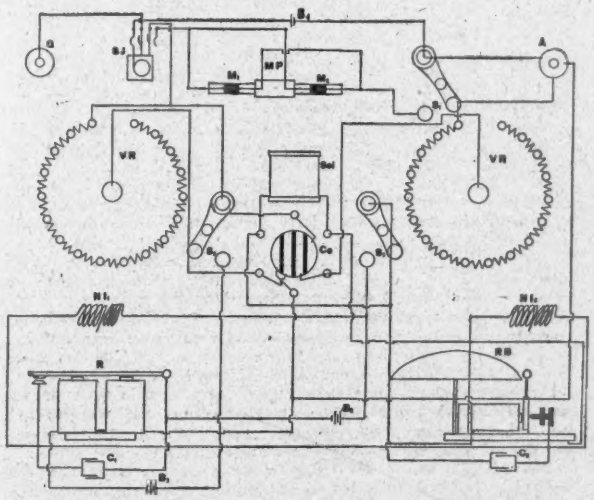
below the condenser switch, and controls the operation of the former. Both of the preceding switches are of the indicating snap type, and when the coil is not in use they should point to "*off*."

The wires leading from the coil to the Leyden jar battery are connected directly to the condenser and coil, and thence to the high-frequency terminals. The proper length of the spark-gap can be ascertained by the nature of the spark. It should be small enough to prevent the appearance of a yellow flame or stringy spark. The gap should be about $\frac{3}{4}$ in., and the spark white, thick and solid.

The aerial wire and ground connections are made with insulated connecting cables and aerial switch and ground plug terminals; the aerial switch is of the double-throw type, enabling the aerial to be used for either transmitting or receiving as desired. The aerial and ground cables are provided with plugs to fit into the aerial switch and the ground connections of the transformer. For the aerial wire 500 ft. of No. 14 bare stranded and tinned copper wire is used. This can be arranged in the best manner for the work and conditions. The ground cable is attached to a wire netting which can be spread out on the ground or dropped into water, or, if longer transmission is desired, it may be buried. A good ground is a very essential feature to accurate signalling.

Storage batteries for supplying energy to the transmitting coil are arranged as portable as possible; these consist of 12 cells in three cases of four each. The batteries will stand a charging rate of 8 amperes for 10 hours. The current used is approximately 4 amperes at 20 volts, though this wattage varies a trifle according to the adjustment of the breaking points of the interrupter in the primary circuit of the coil.

The portable receiving instrument case is divided into two parts, *i.e.*, the case itself, and the top or cover. The cover is hinged and held down by two catches on the sides. On the top of the cover all the receiving instruments are mounted, the connections being made on the underside so that the wiring is concealed. Fig. 3 is a diagram of the connections.



A, Aerial plug terminal; G, Ground terminal; S J, Spring-jack for plugging in telephone receivers; M P, Microphone with M_1 and M_2, showing granular carbon and mercury between the electrodes; B_1, Small battery for microphone circuit; s_1, Switch for microphone circuit; C O, Coherer; V R, Adjustable non-inductive resistance to adjust the sensitiveness of the coherer at the filing gap; s_2, Switch coherer circuit; R, Relay; B_2, Battery relay circuit; B_3, Battery and attention bell circuit; R B, Relay bell for calling attention of the operator when station is called; SOL, Solenoid, which is connected across the magnets of the attention bell, and which operates small armature of coherer not shown in drawing; S_3, Switch for attention bell; $N I_1$ and $N I_2$, Non-inductive coils; C_1 and C_2, Small condensers to prevent arcing at the relay points.

FIG. 3.—RECEIVER CIRCUITS.

The receiver includes a relay with split core wound to a resistance of 1,000 ohms. The tongue of the relay is held in a definite position by means of fine adjustments, which are easily made. The magnet windings and core may thus be brought closer to the tongue of the relay, an advantage when working with a small amount of current. The calling, or filings, coherer is constructed so that the filings are arranged magnetically. The coherer proper is attached to a hard-rubber base, and has connecting points fitting into a hard-rubber receptacle, making it easy to remove it and substitute another if it is desirable to do so.

The coherer gap is sub-divided so as to make a multiple surface as shown in the sectional drawing, fig. 4. Referring to the diagram, fig. 3, it will be observed that by means of the adjustable non-inductive resistances arranged on either side of the coherer circuit it is possible to vary the sensitiveness of the coherer circuit at the filings gap, and also to vary the surface of the electrodes and filings, and, finally, by this means, the resistance of the relay circuit may be adjusted within certain limits.

Mounted on a hard-rubber receptacle, which holds the coherer socket, are two upright brass supporting rods connected electrically with a solenoid formed of magnet wire wound on a hard-rubber core. The terminals are attached to two binding posts, and these are adapted to slide over the supporting rods, and can be secured to any point. At the bottom of the solenoid is the coherer, fig. 4, and inside the hollow rubber core and the glass tube of the coherer is a small armature, the point of which normally rests upon the filings.

When the filings cohere, the relay circuit is closed, which, in turn, closes the attention bell and solenoid circuit. When the windings of these are energised, the bell rings, the coherer armature is magnetised, and, in consequence, is drawn up, when the circuit through the coherer is broken, and the relay is released. The adjustments of the relay, solenoid and attention bell are all simple and easy to manipulate. Mounted on the cover of the receiving case is also a relay switch, and a bell switch for opening these circuits; when the call bell is not in use, these switches should be open.

It is evident from the above that the coherer described is available only in connection with the call bell. To equip this set with

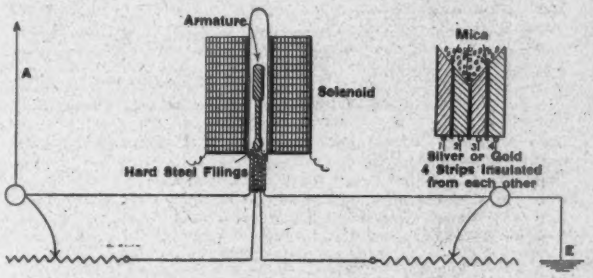


FIG. 4.—CALLING COHERER.

a simple receiver, there is mounted at the front of the receiving case a simple steel, carbon and mercury microphone detector. This is supported on a hard-rubber base. The electrical connections are made through a spring-jack and plug to a pair of head telephones in such a way that by inserting the plug in circuit the filings coherer and relay are cut out, and when the plug is withdrawn from the spring-jack, the coherer and relay are cut in.

At each end of the front of the cover, a spring-jack is provided for the aerial and ground connections, and the connections for the aerial and ground are made to the receiver case by inserting the pair of plugs which are attached to the flexible braided cable, likewise arranged with plugs at each end for connecting to the main switch and ground plug. Switches are provided on the receiving instrument to close and open the following circuits, viz., the battery circuit to the filings coherer and relay, the battery circuit to the attention bell and solenoid, and the battery circuit to microphone detector to cut out the battery and ground connections when operating the transmitting end.

Dry cells are used in the receiving circuits, and these work when the detector circuits are normally adjusted at from 1·3 volts to 1·5 volts. The cells are securely held in position by a stiff brace, which is clamped into place by catches. To test the cells and examine the wiring, the catches at the sides of the case can be loosened and the cover thrown back, exposing all the parts of the apparatus. The facility with which these portable sets can be transported, set up, and taken down, has astonished even those in charge of the equipments.

These sets are in use by the U.S. Signal Corps of the War Department at Fort Hancock, Fort Wodsworth, Fort Wood, Fort Miche, Fort Terry and Fort Schuyler, N.Y., and also by the U.S. Navy at naval stations in Cuba and the Philippine Islands.

LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names may be made. Answers are furnished by a barrister-at-law.*]

No. 91.—*Supply of Electricity.—Electric Radiator.—Supply through Lighting Meter.—Rights of Consumer.*

"'A,' who is already supplied by Municipal Authority with electricity for lighting purposes, and who charges small portable accumulators through lamp resistances, makes formal application for supply for radiator at power rate as advertised. Some days elapse, and he is told verbally that the whole of his supply will be changed to a higher voltage. 'A' objects, and nothing is done; meanwhile 'A' takes current for radiator from his ordinary supply, registering through lighting meter.

"When account for December quarter becomes due, 'A' deducts difference in cost between lighting and power rates for estimated number of units used by radiator, is threatened with legal proceedings by Municipal Authority, and then pays the deductions under protest, because application form was not sent in till early in December.

"Account for March 'A' disputes, and has not yet paid.

"Incidentally, applications to the Town Clerk, asking whether copies of the Acts of Parliament granting powers are to be seen at the Town Hall, have been ignored.

"1. Are supply authorities under any obligation to give supply for radiator at power rate as advertised, or can they accept or decline at will?

"2. Can they change voltage of existing supply without consent of 'A'?

"3. Can they maintain their claim for the full amount of March account without making allowance for current used for radiator?"

*** As to (1), it is provided by the Electric Lighting Act, 1882, Sec. 19, that where a supply of electricity is provided in any part of an area for private purposes, then every company or person within that part of the area shall be entitled to a supply on the same terms on which any other company or person in such part of the area is entitled under similar circumstances to a corresponding supply. Sec. 20 of the same Act provides that there must be no undue preference. It would appear from these sections that if the company have a power rate, they must supply power at that rate if so required. But they would be entitled to insist on a power meter being used.

As to (2), it is clear that a company or local authority supplying electricity cannot capriciously change the voltage of their supply. They can only do so in accordance with the regulations of the Board of Trade. Those regulations provide, amongst other things, that pressure cannot be altered unless the company are prepared to pay the reasonable cost of, or incidental to, the change, including compensation for any damage incurred in consequence of the change. If there is a dispute, it must be settled by arbitration. (These regulations may be found in "The Law Relating to Electricity," by J. Shiress Will (1903), pages 255 *et seq.*)

As to (3), it is difficult to answer this query without having access to a copy of the agreement between company and consumer. It is apprehended, however, that all current which passes through a lighting meter must be paid for at lighting rates.

THE CASE FOR LOW PRESSURE.

By A. C. HANSON.

With the advent of metallic filament glow lamps, the advantages of low pressure electrical supply are being more generally admitted, though probably few electrical engineers in this country would be ready to assert that these advantages out-weigh those obtained by the use of the higher pressures. Even before the introduction of the metallic filament lamp, the superior efficiency of the low voltage carbon filament lamp was recognised, though it had little or no effect in stopping the change from low to high pressure; perhaps because station engineers believed that the lamp makers would rise to the occasion, and produce a high voltage lamp as good as the 100-volt lamp of 10 years ago. But that hope is now faint indeed; the advance of the lamp manufacturers has been an Irish one; they have slipped back two steps for every one they have gone forward. In the opinion of those best qualified to judge—*vide* the discussion on Mr. Clifford Paterson's paper before the Institution of Electrical Engineers—the 200-volt lamp of the present day is even worse than the lamp produced in the early days of high pressure distribution. Whether this unfortunate state of things is due to the demand for a low priced lamp, or to bad pressure regulation, or to original sin in the lamp makers, is debatable; but the result is equally deplorable in any case.

It is curious that we, who, as a nation, have been somewhat too apt to follow the American lead in matters electrical, should have taken up a position of "splendid isolation" on this question, as not only in America but on the Continent, low pressure is the rule and high pressure the very rare exception.

The present time, when electrolytic copper bars are quoted at about £107 per ton, may seem a bad one in which to advocate a system which undoubtedly would mean more copper; but, assuming that the copper market is in a somewhat abnormal condition, a fair case may be made out for low pressure in many towns where the present supply is the usual high pressure one.

The reason for the adoption of what we call high pressure, and the Americans "double voltage," may be summed up in one word—copper. Just as in the case of the three-wire system, so with high pressure distribution, the saving in copper was the sole, and remains by far the most important, reason for its adoption. Now, this saving is a very solid reason, and, as hinted above, the present high price of copper gives it far more weight than it possessed at the time of its introduction into this country. Against it, however, there can be set a number of advantages which are gained by the use of low pressure, and these, in the aggregate, may be found to be of more importance, in many cases, than the saving in copper.

That economy in copper has been carried too far in this country, will be admitted by all who are acquainted with the conditions of electrical supply in many of our large towns, where "bad" is too feeble a word to use in describing the pressure regulation. How often has it been stated that it is the duty of station engineers to sell light, and not Board of Trade units, and when will this elementary fact be realised? With a statutory declared voltage of 250, in reality ranging from 240 to 270, the light given by a 250-volt lamp is a very variable quantity, but is not often that at which it is rated. The price per B.T.U. by itself is only a very rough indication of the cost of electric light, a number of other factors having to be taken into account before the relative costs of two supplies can be determined. If it can be demonstrated that, *cæteris paribus*, low pressure supply is approximately 25 per cent. more efficient than high pressure, the necessity for the almost universal adoption of high voltage in this country may well be doubted.

Practically all the different types of lamps are better on low than high voltages; the carbon filament lamp is more efficient, the metallic filament lamp may be used singly, the open type arc lamp may be burned economically in pairs, and the enclosed arc lamp singly. The only commercial lamp that is better on high than low voltages is the Nernst, and few consumers would be sorry if this type of lamp was as dead as Queen Anne, if they could use metallic filament lamps without being under the necessity of running them in series. The initial efficiency of the Nernst lamp, though probably never as high as is claimed by the makers, is certainly better than that of the carbon filament lamp, but its very rapid deterioration and general unreliability make it but a doubtful blessing to users of electric light.

Dealing first with the carbon filament lamp: it is not an extravagant estimate to assume 20 per cent. higher efficiency for the low voltage lamp in the ordinary sizes. Mr. Alex. Dow, in his paper on D.C. distribution read before the St. Louis Electrical Congress of 1904, arrived at this figure, and, if anything, he understated the case. In the smaller candle powers, the high-voltage lamp is very bad; the 5 C.P. 220 volt lamp is inefficient and unreliable, and smaller candle powers than five are almost impossible. Now, in spite of all that has been said lately on the subject of increasing the unit of light, an efficient 5-C.P. lamp is a useful aid to the station engineer. It is most depressing to go into a house or hotel, which is wired throughout, and find the dark basement passages and stairs lighted all day by "peeps" of gas, because "electric light is too expensive"; in other words, because even the 8-C.P. lamp gives more light than is required, and costs far more than the "peep" of gas. In many places an efficient lamp, of as low a candle-power as three, would be most useful. Candle lamps also, and the other forms of small bulb lamps, are so inferior on high voltage, that it is the practice to run them in series, with the usual results in the way of trouble and annoyance. Finally, low-voltage carbon filament lamps are from 20 to 25 per cent. cheaper in first cost than high-voltage lamps.

With metallic filament lamps, the case for low pressure is much stronger. Even at 110 volts, the smallest candle-power obtainable at high efficiency is over 20, and whatever may be done in the near future, it is difficult to believe that a satisfactory low candle-power lamp at 220 volts will be

produced. At present, of course, practically all the metallic filament lamps have to be run in series on the high voltages, and this is inconvenient in nearly all cases, and quite unsuitable in many. The high efficiency of these lamps, compared with the carbon filament lamps, and their positive temperature coefficient, which renders them much less susceptable to variations of voltage than their carbon rivals, are advantages which are obvious enough to have enabled this form of lamp to become exceedingly popular even on high-voltage systems. How much more generally useful they are on low-voltage circuits, can be readily understood, especially by those unhappy mains engineers who have had to explain to dozens of consumers that "these lamps have to be used in pairs on our supply."

In the case of arc lamps, the advantages of low pressure are not so great; but, even here, they are considerable. At the present time, the arc lamp, in its various forms, is the most efficient light-giver at our disposal, and is the best weapon with which to fight the more efficient of the many types of incandescent gas lamps. Where quantity of light is the only requirement, the flame arc lamp is probably the only form of electric lamp—at the average rates of charge—which will show a decided economy over the latest form of high-pressure gas lamp. Many shop keepers would be glad to have two high candle-power lamps outside their premises, while they do not require such a powerful light inside. If the alternative is between two high-pressure gas lamps, and four flame arc lamps, in many cases the gas lamps will win the fight. It is, generally speaking, only in the larger shops that as many as four arc lamps are wanted outside, or any inside. If arc lighting is required inside, enclosed lamps are generally preferred, and in such a case the advantage of single control is great and readily appreciated. There is, of course, the twin enclosed arc lamp, made to burn singly on high voltages; but, though very ingenious, these lamps are not really satisfactory, and do not compare, either in efficiency or reliability, with the 110-volt enclosed arc lamp. As in the case of the carbon filament lamp, the lamps for low voltage are, as a rule, cheaper than those for high pressures.

Coming now to the question of motors: it has generally been taken for granted that high voltage is more suitable than low for motive power supply. In the case of large motors, the advantages of high pressure may be allowed; but the great majority of motors are now, and will be much more in the future, of a size more suited to low voltage. Both in America, and on the Continent, very small motors, of from $\frac{1}{10}$ to 1 H.P., are in use in enormous quantities, doing all kinds of household and small industrial work, and the field for such motors in this country would also be very large, if the available voltage was suitable. In a paper read before the Municipal Electrical Association in 1906, Mr. F. J. C. Snell estimated the consumption per head in a small town at a figure far in excess of the average results of the present day. Mr. Snell subsequently pointed out that his figures were arrived at on the assumption that a use would be made of the electrical supply, similar to that made on the Continent. Such a result will hardly be arrived at where high pressure is in use, as a $\frac{1}{4}$-H.P. motor on 220 volts is a rather undesirable piece of mechanism, and anything much smaller than this is practically impossible. From the supply station point of view, there is another advantage in low-pressure supply to motors, and that is, that it is practicable to have all motors of, say, 2 H.P. and over, connected across the outers of the three-wire system. Even a 2-H.P. motor, if geared direct to a printing machine, or similar apparatus, will sometimes make itself felt in an unpleasant manner when connected on one side of the system; whereas, on the outers, practically no variation of pressure will be caused by its performances. Anything tending to the betterment of pressure regulation should be welcomed alike by consumer and station engineer.

Heating, in its various forms, is a field that is hardly touched as yet by electric supply stations, and the slowness of the advance in this department is due, at least in part, to the prevalent high voltage. All kinds of electrical heating apparatus are more reliable on low than on high voltage, and most of them, especially the smaller utensils, are cheaper also. Now, it is just in these smaller articles, such as shaving pots, tea kettles, irons and hot water jugs, that the beginning of an electric heating supply is made. Only a very small proportion of the customers of electricity works can be induced to install electrical heating and cooking apparatus to any great extent; but it is not difficult to persuade a fair number to try one or two small articles, such as have been mentioned. If these operate with perfect satisfaction, the thin edge of the wedge is firmly in place, ready to destroy the mass of prejudice in favour of dirty coal fires and poisonous gas stoves and irons. But, above all, the electrical apparatus must be reliable, and the utmost reliability is attained on low voltages. Probably 50 per cent. of the failures in electrical heating apparatus—at any rate, in the case of the smaller articles—are due to the high voltage at which they have to work, 40 out of the remaining 50 per cent. being caused by carelessness on the part of the user.

The last point appealing directly to the consumer, is that of electric shock. A 220-volt shock is decidedly disconcerting to nearly all, and absolutely dangerous to some; whereas a 110-volt shock would hardly be felt by the majority. Of course, no one should be exposed to the risk of shocks; but in these days of jerry wiring and jerry building, the marvel is that so many escape. Obviously, the standard of insulation does not require to be as high for 110 volts as for "double voltage," and this would tend to counterbalance, to some extent, the cost of the extra copper required for low-pressure supply, if, as some maintain, rubber is still used in the manufacture of wires for electric work. Finally, on this point, the Continental system of wiring by means of flexible wire run on porcelain insulators would have a much better chance of being passed by the insurance companies, if the pressure of supply were a low one.

In this country, at the present time, a meter is regarded as an almost indispensable link between the consumer and the supply station; though whether this state of things will be maintained much longer is, as Rudyard Kipling says, "another story." Dealing with affairs as they are now, however, it will be conceded that a meter, in some form or other, is generally necessary. It would be most interesting to know what is the average proportion of the number of units not registered on consumers' meters to the number given under the heading "Quantity not accounted for." Without having exact figures, it is yet certain that this proportion is a very high one, and of these units, the majority are lost through the inaccuracy of the meters at very light loads. Even with careful supervision, it is impossible to insure that a large proportion of the meters will even start on a 220-volt 8-C.P. lamp; while the degree of accuracy on loads of this order is almost sure to be very low. It is not advisable to mention names, but a certain make of ampere-hour meter, for which is claimed—in common with most of the London daily papers—"the largest sale in the world," though remarkably accurate on all loads above about 1/5 of its capacity, is commonly as much as 10 per cent. slow below 1/10 load. Though these losses may seem trifling when considered separately, in the aggregate they often amount to a "demnition total"—to quote Mr. Mantalini. Naturally, ampere-hour meters are no more accurate on low voltage than on high, but they are not run on such light loads, and there is not the same chance of a consumer being able to burn an 8-C.P. lamp all day without the meter taking notice of the fact.

Except as a consequence of the comparatively high efficiency of low-voltage lamps, the generation of low pressure does not present many advantages; the chief, if not the only one, being in the construction of the storage battery. For the same output in KW.-hours, the cells will be fewer and larger, and the battery will thus be cheaper, both to buy and to maintain. It must also be remembered that, owing to the superior efficiency of the low-voltage lamp, a 220-volt battery of a given output has in reality a greater "light capacity" than an equally rated 440-volt battery. This also applies, of course, to all the generating plant; and as station engineers are dealing in light, and not in KW.-hours, plant rating should, rationally, take some account of the efficiency of the means of converting the electric energy supplied into light. For a given "peak" load capacity—the "peak" is practically always a lighting load—the rated output, and consequently the price, of the station plant will be less for a low, than for a high, pressure supply.

NEW PATENTS APPLIED FOR, 1907.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

11,853A/06. "Improvements in means for compensating load variations in electrical installations." J. Y. JOHNSON. (The Felten & Guilleaume-Lahmeyerwerke, Akt.-Ges., Germany.) (Date applied for under Rule 5 of the Patents Rules 1905, May 21st, 1906.) July 9th. (Complete.)

15,620. "Improvements relating to apparatus for the automatic regulation of dynamo-electric machinery." J. PILLING and C. H. KLYNE. July 8th.

15,634. "Improvements in and relating to systems for controlling electrical devices." W. E. EBERT. July 8th. (Complete.)

15,636. "Improvements in automatically-operated station indicators for electric railways." M. DALEY and P. DALEY. July 8th. (Complete.)

15,642. "Improvements in collecting the electric current for the working of electric trams or railways." J. D. ROSS. July 8th.

15,646. "Improvements in the insulation of submarine cables for telegraphic and telephonic purposes." J. JOHNSTONE. July 8th.

15,648. "Improved regulating starter for single-phase and polyphase induction motors." J. BRUNCKEN. July 8th. (Complete.)

15,692. "Improvements connected with the manufacture of metallic sodium by electrolysis." H. BAKER. July 8th.

15,693. "Improvements in the manufacture of metallic sodium by electrolysis." H. BAKER and E. HAWORTH. July 8th.

15,715. "Improvements in electric arc lamps." F. W. E. SCHUER. July 8th.

15,731. "Improvements in and relating to ignition devices for internal combustion engines." A. M. LODGE. July 9th.

15,751. "Improved high tension cable." A. E. TANNER and E. A. CLAREMONT. July 9th. (Complete.)

15,755. "Ear guard with holding attachment for telephone receivers." A. ANKER. July 9th. (Complete.)

15,769. "Improvements in and relating to electrical railway systems." L. BEECKER. July 9th. (Complete.)

15,789. "Improvements in and relating to receiving instruments for electric telegraphy." R. H. EDGAR. July 9th.

15,798. "Electric incandescence lamp with U or V-shaped supported metal filaments." H. KUZEL. (Date applied for under Patents Act, 1901, May 31st, 1907, being date of application in Germany.) July 9th. (Complete.)

15,810. "Improvements in or relating to sectional induction coils." C. A. PFANSTIEHL. July 9th. (Complete.)

15,816. "Improved apparatus for electro-plating small articles." J. L. CLARKE. July 10th.

15,820. "Improved type of permanent magnet generator." G. W. SOMERVILLE. July 10th.

15,824. "Improvements in or in connection with incandescent electric lamps." A. SCHWARTZ and C. C. METCALFE. July 10th.

15,830. "Improved mould for casting electric accumulator grids." W. FENNELL and W. P. PERRY. July 10th.

15,834. "Improvements in induction motors and in the method of starting, connecting up and controlling the speed of combinations of such motors operated from a single-phase supply." J. L. LA COUR. July 10th. (Complete.)

15,841. "Locating and telephonic device for submerged submarines." H. A. TANDY. July 10th.

15,846. "Improvements in methods of electrical distribution." W. FENNELL and W. P. PERRY. July 10th.

15,847. "Improvements in or relating to axle-box suspension devices for electric tramcars and the like." MOUNTAIN & GIBSON, LTD., and G. LAURIE-WALKER. July 10th.

15,857. "Improvements in and relating to electric arc lamps." J. O. GIRDLESTONE and C. F. G. THORKELIN. July 10th. (Complete.)

15,878. "Improved electrically-controlled selective switch and a transmitter of current impulses for use therewith." SIEMENS BROS. & Co., LTD., and G. S. GRIMSTON. July 10th.

15,922. "Electric winch." T. P. POLLITT. July 11th.

15,966. "Improvements in and relating to electric lamps for carriages, motor-cars and the like." C. A. VANDERVELL. July 11th.

16,027. "Improvements in arc lamps." J. C. CHALMERS and W. A. ROBERTSON. July 12th. (Complete.)

16,034. "Improvements in the construction of a pocket electric lamp worked with secondary battery applicable for various purposes." W. THOMSON. July 12th.

16,044. "Improved lamp cap and holder for electric incandescent lamps having more than one filament." F. HARRISON. July 12th.

16,051. "Improvements in or relating to dynamo-electric machines." SIEMENS BROS. DYNAMO WORKS, LTD., and W. PARKER. July 12th.

16,052. "Improvements in or relating to dynamo-electric machines." SIEMENS BROS. DYNAMO WORKS, LTD., and W. PARKER. July 12th.

16,053. "Improvements in arc lamps." H. S. HATFIELD and F. M. LEWIS. July 12th.

16,073. "Improvements in electrically-operated cloth-cutting machines." R. P. J. WILLIS. (E. M. Waring, United States.) July 12th.

16,087. "Telephone alarm with attuned call." J. W. MACKENZIE. (C. Lorenz, Germany.) July 12th. (Complete.)

16,091. "Improvements in and relating to electric switches." BRITISH THOMSON-HOUSTON CO., LTD., and E. B. WEDMORE. July 12th.

16,092. "Improvements in and relating to alternating-current machines of the commutator type." ALLGEMEINE ELEKTRICITÄTS GES. (Date applied for under Patents Act, 1901, July 13th, 1906, being date of application in Germany.) July 12th. (Complete.)

16,098. "Improvements in apparatus for electro-plating." S. O. COWPER-COLES. July 12th. (Complete.)

16,145. "Improvements in or relating to safety electric apparatus for lighting miners' safety lamps." J. C. BOWIE and J. H. PHELPS. July 13th.

16,166. "Improvements relating to the supplying of current to electric motors." J. S. HIGHFIELD. July 13th.

16,175. "Improvements in means for attaching flexible conductors to commutator brushes, and also applicable for uniting other bodies or articles." THE MORGAN CRUCIBLE CO., LTD., and C. D. MCCOURT. July 13th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1906.

ELECTRIC HEATERS. British Thomson-Houston Co. (General Electric Co.) 11,657. May 18th.

ELECTRO-MAGNETICALLY CONTROLLED SWITCHES AND CIRCUIT BREAKERS. P. S. Brook and J. A. Hirst. 13,517. June 12th.

ACTUATING MEANS FOR ELECTRIC SWITCHES. G. M. Newbery and British Prometheus Co. 13,818. June 16th.

ELECTRIC FURNACES. S. Z. de Ferranti. 13,949. June 18th.

ELECTRIC FURNACES. S. Z. de Ferranti. 13,949A. June 18th. (Date applied for under Rule 5, Patents Rules 1905, June 18th, 1906.)

ELECTRIC PLANT FOR PRODUCING CHEMICAL REACTIONS. I. Moscicki. 14,259. June 21st. (Date applied for under International Convention, January 17th, 1906.)

CONDUIT FITTINGS FOR ELECTRIC WIRES AND CABLES. Oldbury Steel Conduits, Ltd., and J. Sutton. 14,289. June 22nd.

INTERNAL COMBUSTION ENGINES. J. David. 14,475. June 25th.

DYNAMO-ELECTRIC MACHINES. V. A. Fynn. 14,501. June 25th.

ELECTRIC SWITCH APPARATUS. G. C. Fricker. 14,589. June 26th.

MAGNETO-ELECTRIC GENERATORS. Albion Motor-Car Co. and T. B. Murray. 14,737. June 28th.

ELECTRIC CURRENT COLLECTING DEVICES. British Thomson-Houston Co. (General Electric Co., U.S.A.) 14,788. June 28th.

ELECTRIC SPARKING MECHANISM APPLICABLE ESPECIALLY FOR EFFECTING IGNITION IN INTERNAL COMBUSTION ENGINES. Marconi's Wireless Telegraph Co. and E. Priddle. 15,910. July 13th.

SPEED REGULATION OF CONTINUOUS-CURRENT ELECTRIC MOTORS. M. J. E. Tilney. 15,989. July 14th.

ELECTRIC ACCUMULATORS. C. Haunz and A.B.P. Accumulator Co. 17,539. August 3rd.

WIRELESS TELEGRAPH SYSTEMS. De Forest Wireless Telegraph Syndicate. (L. de Forest.) 19,881. September 6th.

METALLIC GLOW-BODIES FOR ELECTRICAL APPARATUS. A. Lederer. 20,209. September 11th.

BRUSH-HOLDERS FOR DYNAMOS, ELECTRIC MOTORS AND SIMILAR MACHINES. Johnson-Lundell Electric Traction Co. and H. Lübeck. 22,617. October 12th.

ELECTRICAL CONDUIT FITTINGS. W. Schmahl and Armorduct Manufacturing Co. 22,789. October 15th.

COMBINATION ELECTRIC ALARM AND PRESSURE GAUGE FOR FORCED LUBRICATION. H. E. Sharpin. 23,469. October 26rd.

IGNITING DEVICES FOR INTERNAL COMBUSTION ENGINES AND THE LIKE. S. Brotherhood and C. W. Bryant. 25,096. November 7th. (Secret document under Section 44, Patents Act, 1883.)

CONTROL SYSTEM FOR ELECTRIC LIFTS OR ELEVATORS. W. Sprowson, L. G. Hall and W. G. Burn. 25,209. November 8th.

ACCUMULATOR CELLS. H. Leitner. 25,761. November 14th.

BRAKING ELECTRIC HOISTS AND THE LIKE. Siemens Bros. Dynamo Works, Ltd. (Siemens Schuckertwerke Ges.) 26,152. November 19th.

APPARATUS FOR SIGNALLING BY MEANS OF ELECTRO-MAGNETIC WAVES. L. de Forest. 27,988. December 7th. (Date applied for under International Convention, December 8th, 1905.)

ELECTRIC HORNS FOR MOTOR VEHICLES AND THE LIKE. L. Palous and P. Nathan. 28,609. December 15th. (Date applied for under International Convention, June 19th, 1906.)

ELECTRICALLY-PROPELLED RAILWAY AND TRAMWAY VEHICLES. W. Cooper. 29,482. December 27th. (Date applied for under International Convention, January 3rd, 1906.)

BAYONET CAPS FOR ELECTRIC GLOW LAMPS. G. Davis. 29,620. December 29th.

MAGNETIC CLUTCHES. R. W. Ravenshaw, V. G. Middleton and W. R. Townsend. 14,517. June 25th.

ELECTRIC CIRCUIT BREAKERS AND MAKERS. J. G. Statter. 14,577. June 26th.

ELECTRIC RAILWAYS WORKING ON THE SURFACE CONTACT SYSTEM. E. Rothwell. 14,615. June 26th.

ELASTIC FLUID GENERATING SYSTEMS AND APPARATUS FOR CONTROLLING THE SUPPLY OF FUEL AND VAPORISABLE LIQUID THERETO. British Thomson-Houston Co. (General Electric Co.) 14,695. June 27th.

METHOD OF PRODUCING METALLIC INCANDESCENCE BODIES FOR ELECTRIC GLOW LAMPS. Deutsche Gasgluhlicht Akt.-Ges. (Auer-ges). 14,816. June 28th. (Date applied for under International Convention, October 28th, 1905.)

POINT SHIFTING ARRANGEMENTS FOR ELECTRIC TRAMWAYS AND THE LIKE. J. P. Tierney and J. Malone. 15,016. July 2nd.

ELECTRIC SWITCHES. W. F. Jones. 15,428. July 7th.

INSULATORS FOR ELECTRIC RAIL OR TRAMWAYS. P. T. J. Estler and C. S. Drake. 15,587. July 10th.

APPARATUS FOR THE ELECTROLYTIC PRODUCTION AND SEPARATE COLLECTION OF GASES. J. Wetter. (Elektricitats-Aktiengesellschaft vormals Schuckert and Co.) 17,981. August 10th.

METALLIC CASES FOR MOTOR STARTERS, SWITCHES, FUSES AND THE LIKE ELECTRICAL APPARATUS. P. S. Brook and J. A. Hirst. 18,365. August 16th.

TIME AND LIKE SWITCHES, ESPECIALLY APPLICABLE FOR USE WITH ELECTRIC METERING APPARATUS. Allgemeine Elektricitats-Ges. 18,486. August 17th. (Date applied for under International Convention, August 19th, 1905.)

METHOD OF HEATING MOLTEN OR SEMI-MOLTEN MATERIALS BY ELECTRICITY. F. Wynne. 18,835. August 22nd.

ELECTRIC TRANSFORMERS. British Thomson-Houston Co. (General Electric Co.) 19,548. September 3rd.

CONNECTIONS FOR GRAPHITE CARBON ELECTRODES. P. Schoop. 21,769. October 2nd.

ELECTRIC ARC LAMPS. British Thomson-Houston Co. (General Electric Co.) 21,874. October 3rd.

MAGNETO-ELECTRIC IGNITION APPARATUS. F. Munz. 22,323. October 9th.

CARBON HOLDERS FOR MICROPHONES. W. A. W. E. Hjorth. 24,689. November 3rd.

CONSTRUCTION OF ELECTRIC ACCUMULATORS. Q. Marino and E. W. Barton-Wright. 26,940. November 27th.

SPARKING PLUG FOR USE IN EXPLOSION ENGINES WITH ADJUSTABLE AND VISIBLE SPARK. G. A. E. Delalande. 27,144. November 29th.

ELECTRIC ARC LAMPS. New Century Arc Light Co. and H. Baggett. 27,640. December 4th.

VENT VALVES FOR GALVANIC BATTERIES. P. J. Schalow. 28,015. December 8th.

INSULATOR FOR ELECTRIC CONDUCTORS. A. Boltshauser. 29,176. December 21st.

UNI-POLAR DYNAMOS. W. Matthiesen. 29,193. December 21st.

ELECTRIC TRANSFORMER FURNACES. O. Frick. 29,271. December 22nd. (Date applied for under International Convention, December 27th, 1905.)

TELEPHONE APPARATUS. A. Friedlander. 29,476. December 22nd. (Date applied for under International Convention, September 17th, 1906.)

1907.

FIELD WINDINGS FOR DYNAMO-ELECTRIC MACHINES AND MOTORS. Siemens Bros. Dynamo Works, Ltd. (Siemens Schuckertwerke Ges.) 7,695. April 2nd.

ELECTRIC SHUNTS. J. B. D'Homergue. 7,711. April 2nd.

ELECTRIC TROLLEY LINE CONSTRUCTION. T. Varney. 12,458. May 29th. (Date applied for under International Convention, June 4th, 1906.)

TIME INDICATOR FOR PERSONS USING THE TELEPHONE. S. Cunningham. 42. January 1st.

ALTERNATING CURRENT COMMUTATING MACHINES, THE MAGNET FIELDS OF WHICH ARE EXCITED BY THE ARMATURE. Allgemeine Elektricitats-Ges. 99. January 1st. (Date applied for under International Convention, January 29th, 1906.)

TELEPHONE EXCHANGES. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 282. January 4th.

TELEPHONE INSTALLATIONS HAVING CENTRAL AND LOCAL EXCHANGES WORKED BY A CENTRAL BATTERY. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 287. January 4th.

Bruce Peebles

& Co. Limited,

ELECTRICAL ENGINEERS AND CONTRACTORS,

London and Edinburgh.

Advertising Supplement No. 6. JULY, 1907.

FIG. 1.—PEEBLES BALL-BEARING "C" TYPE MOTOR.

Continuous Current Motors.

"C" Type.

THE "C" Type Motor is the direct successor of the earlier patterns of Peebles Continuous Current Motor, and embodies the results of an experience acquired in the manufacture of nearly 150,000 of such machines. New features of great value have been added to the motors, as will be seen from the description in the following pages. In short, the P.P.P. Motor is now better than ever.

"C" Type Continuous Current Motors.

General Type.

THE motors are of the usual self-contained type, and may be supplied either "protected," "enclosed ventilated," or "totally enclosed," as required. All parts are standardised and made to jig and template, so that spare parts may be supplied at any time without delay or inconvenience. The machines are handsomely finished and rigorously tested in every case before leaving our works.

Every Motor is fully guaranteed.

FIG. 2.—FIELD FRAME, WOUND, OF "C" TYPE MOTOR.

Bearings.

THE bearings of the larger motors are of the ordinary type, with oil-ring lubrication, but a departure from the usual practice has been made in the smaller machines, these being fitted with ball bearings of a special design, which we have found, after exhaustive experiment, to be thoroughly satisfactory in service. Their use considerably improves the efficiency of the motor, and being automatically lubricated they require no attention.

Bruce Peebles & Co. Ltd.

"C" Type Continuous Current Motors.

FIG. 3.—ARMATURE OF "C" TYPE MOTOR.

Electrical Improvements.

THE motors show a substantial improvement on any results which it has hitherto been possible to obtain, particularly under the following heads:—

1.—Efficiency.
2.—Sparkless Running.
3.—Overload Capacity.

Absolute sparklessness under all conditions of load is ensured by the use of a properly designed field system with commutation poles. Special attention has also been paid to insulation and ventilation. The commutator is amply proportioned, and the brushgear strong and simple.

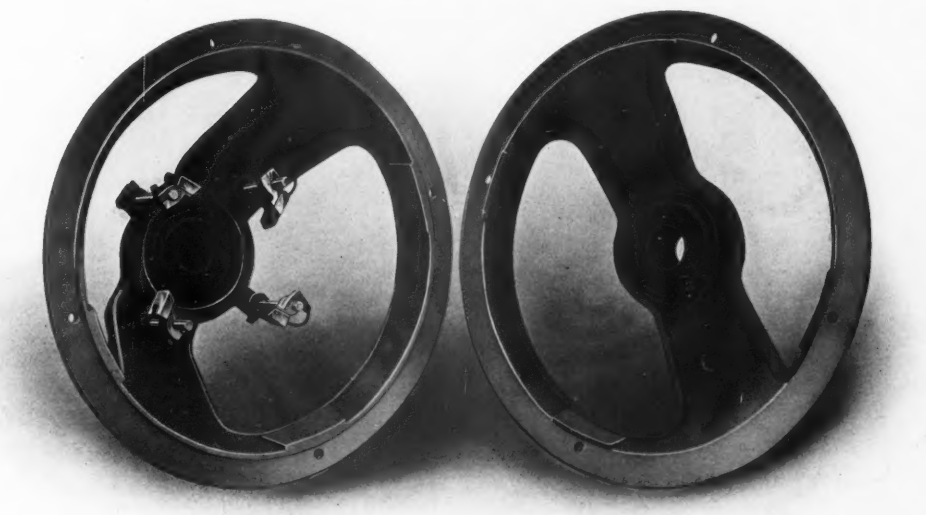


FIG. 4.—END BRACKETS AND BRUSH GEAR OF BALL-BEARING "C" TYPE MOTOR.

Bruce Peebles & Co. Ltd.

"C" Type Continuous Current Motors.

Windings.

Standard motors are shunt wound. Compound or series machines can also be supplied to order.

Voltages.

The motors are wound for all the standard voltages in general use.

Sizes.

There are 16 standard sizes, ranging from $\frac{3}{4}$ H.P. to 200 H.P., at various speeds. Larger machines are supplied in the bed-plate type.

Prices.

The motors are the best value for money which we have ever been able to offer.

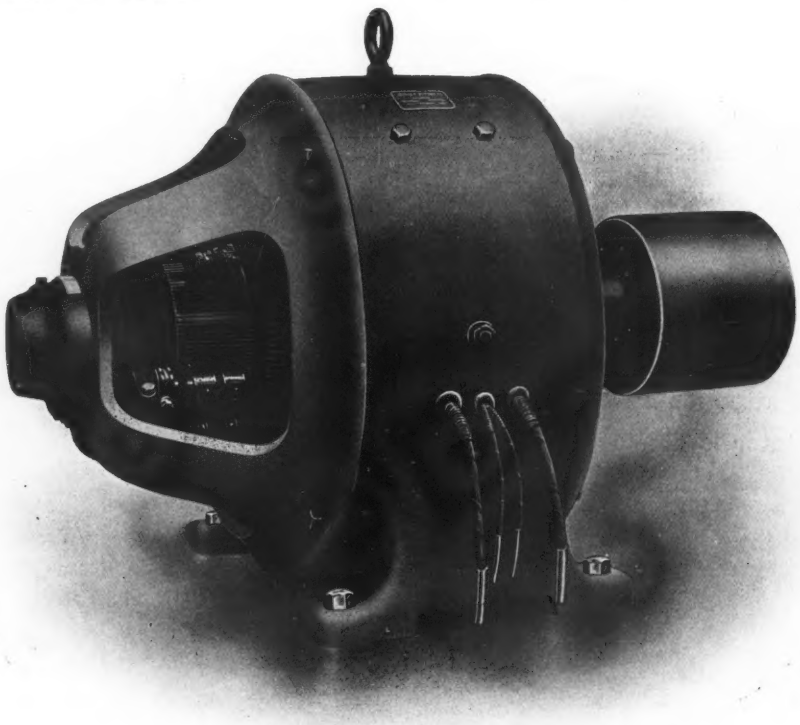


FIG. 5.—LARGE "C" TYPE MOTOR.

Bruce Peebles

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